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SURGICAL TREATMENT OF PERIPHERAL NERVE INJURIES

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THE purpose of this paper is to discuss certain aspects of treatment of peripheral nerve injuries in army hospitals of this country in World War I and to present observations derived from personal experience with these lesions in subsequent civilian practice. The increasing frequency of peripheral nerve injuries in the last quarter of a century has provided material of far more surgical importance than might be indicated by the meager literature in American journals in the decade immediately preceding the present world conflict. It is true that important contributions dealing with the treatment of peripheral nerve injuries, both from clinical work and experimental investigation, were made by a number of those who had been actively engaged in the various reconstruction centers established for the wounded men of the American Expeditionary Forces in 1918. These contributions furnished a sound background for the treatment of nerve injuries in civilian practice and for further investigation of such injuries in the present war.

The observations in this paper on peripheral nerve injuries of warfare are based mainly on the writer's experience in U. S. Hospitals No. 11, Cape May, New Jersey, and No. 41, Staten Island, which were among 12 centers designated by the Government, in 1918, for the treatment of nerve injuries. An effort was made by the Peripheral Nerve Commission to provide all nerve reconstruction centers with competent personnel for the investigation and treatment of such lesions. About 700 cases were under observation in Army Hospitals Nos. 11 and 41 within the

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Fig. 1.[1] Transposition of the musculospiral nerve to the inner side of the arm to permit approximation and suture. a, Scar of gunshot wound; b, distal segment of nerve exposed and removed from musculospiral groove; c, course of the nerve when transposed between the brachialis anticus and biceps to inner side of arm. The usual neuromas are seen on the proximal and distal ends of the nerve; d, completed suture.

Fig. 2. Neurolysis of ulnar nerve and autogenous cable transplants to repair long defect of the median nerve. a, Scar of wound; b, exposure of median nerve; c, further exposure of median, ulnar, and internal cutaneous nerves. The median is completely divided with marked separation of the bulbous nerve ends; d, the cutaneous branch of the musculocutaneous nerve of the leg is exposed to obtain a transplant. The transplants are transferred with fine sutures held in mosquito forceps; e, 9 centimeter defect with transplants sutured in position.

Fig. 3. Gunshot wound of the thigh causing severe injury to the sciatic nerve with the development of a neuroma in continuity. a, A long fusiform neuroma imbedded in dense scar so common in gunshot wounds; b, the nerve above and below the lesion has been exposed; c, cut section of the neuroma shows few funiculi; d, serial sections were continued until healthy nerve ends appeared; e, suture of the nerve in the usual manner. One relaxation suture was used.

[1]Figures 1 to 8 have not been reproduced in color previously. The drawings were made by F. F. Faber from operations done by the writer in U. S. Hospital No. 11, Cape May, New Jersey in 1919.

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year ending August, 1919. The work at these two army hospitals was reported in some detail by various members of the staffs and these reports dealt largely with the clinical examination, electrodiagnosis, operative technique, and general care of patients observed in these centers. The investigation of nerve injuries in the army reconstruction hospitals was carried out by competent neurologists who were given sufficient personnel to make thorough and repeated examinations in all cases.

Practically all soldiers with peripheral nerve injuries were returned to this country for definitive surgical treatment. It was generally appreciated that the problems of peripheral nerve surgery should be dealt with in a reconstruction hospital and not in the war zone. Frazier states that, of the Cape May series of more than 500 cases, only 5 injured nerves had been sutured overseas. Nearly all of these patients had received injury between July and November, 1918, and few operations were performed before January of the following year, the majority being done from April to August, 1919. It should be noted here that there was a considerable period between the injury and secondary surgical treatment for nerve repair. This long delay was unfortunate because it gave ample time for the development of muscular atrophy, fibroses, and other crippling sequelae of long continued denervation. The delay in operation in many of those that needed it badly was due to two principal factors. In the first place there was residual infection in many of the wounds occasioned by osteomyelitis or retained foreign bodies, and this infection was often eradicated slowly.

The attitude toward nerve injuries in European hospitals had been a conservative one and that conservatism had some justification in the reports of a rather considerable percentage of spontaneous recoveries following paralysis of the extremities resulting from gunshot wounds which had not directly injured the nerve but had caused a physiological interruption for varying lengths of time. Frazier believed that about 6 months should be allowed between the injury and operation on the injured nerve. This would allow sufficient time for complete healing of the wound in infected cases and for evidence of spontaneous recovery if this were possible. The conservative attitude which prevailed in the early part of the reconstruction period after the Armistice was perhaps influenced to some extent by the fact that American surgeons at the time were without experience in the treatment of nerve lesions. Few of them had performed as many as a half-dozen peripheral nerve operations prior to 1918. The writer was convinced in his early experience with these injuries at Cape May that the attitude toward exploration of nerve injuries should be more radical than that which prevailed when the peripheral nerve centers were first established in this country, and that exploration of the paralyzed nerve was often the only way to obtain the information necessary to proper treatment.

The factors of delay, such as infection and lack of experience with the treatment of nerve lesions, will not be operative in the present war to the same degree as in 1918. The prevention or control of infection has vastly improved through chemotherapy, thus insuring the practicability of early exploration of the paralyzed nerve and this should be the rule. While accepting the value of chemotherapy for the control or prevention of infection, we feel that it can by no means be a substitute for adequate surgery, nor have we used it in any wounds except those in which we felt that complete disinfection could not be accomplished mechanically with normal saline or Ringer's solution. In this connection, Holmes and Mediwar, following experimental findings, have warned that sulfanilamide should be used locally with caution in operations in which the nerve trunk is exposed. They reported that if as much as 2 grams (a rather large amount under the circumstances) of this drug were applied along the course of the sciatic nerve in rabbits there was histological and functional evidence of nerve damage even though the nerve was protected by a film of fascia.

Another important cause of delay in the suture of divided nerves in World War I was the misleading signs of regeneration which led to failure of recognition of the type of lesion present. Too much reliance was placed on

Tinel's sign which was considered by some in the earlier work at reconstruction hospitals as possessing a high degree of infallibility. Time and again patients with Tinel's phenomenon indicating, as was then supposed, regeneration of the nerve, were found at operation to have separated bulbous nerve ends without the slightest possibility of regeneration.

Nerve injuries of warfare are usually far more complicated than those in civilian life. Comminution of bone and injury to the muscles, large blood vessels and sympathetics of the extremities, often are associated with the nerve lesion. The complexity of war wounds of peripheral nerves not only adds to the difficulty of surgical treatment but also constitutes an important factor in the limitation of functional recovery.

We have seen no case of serious vasospasm associated with peripheral nerve injury in civilian practice. Two cases have been reported by Colonel J. A. McFarlane from experience in the present war. In one case there was a bullet wound of the thigh with a small hemorrhage of the sciatic nerve and the other followed fracture of the tibia and fibula in the middle third, without important vascular injury in either case. One case had a periarterial sympathectomy. Both finally required amputation of the extremity above the knee. Obviously, severe vasospasm, if it develops at all, would develop shortly after injury but a lesser degree of vasospasm may be seen later in cases in which the sympathetics have been injured. In some cases of severe partial nerve lesions in civilian practice, showing evidence of vasospasm with causalgia, we have used injections of the paravertebral sympathetic ganglia for improvement of the circulation of the involved extremity, relief of pain and for its indirect benefit to nerve regeneration by improving the peripheral circulation. We are of the opinion that there might be a wider field for the employment of this procedure in certain partial nerve lesions, particularly those with causalgia.

As the study of peripheral nerve injuries progressed in the Army hospitals in 1919, it became evident from a number of operations that the nerve lesions as a rule were more serious than the clinical study of the patients had indicated. It may be mentioned at this point that the tendency to underrate the extent of nerve lesions or even ignore them altogether is common in civilian practice. A more radical attitude toward exploration gradually developed in the Army cases which showed no improvement. It was not recognized at the time that exploration of a nerve is the only satisfactory way to obtain exact information as to the true nature of the lesion in many cases. When there is complete paralysis of a nerve following gunshot wound, we believe that exploration of the nerve should be done as soon as the condition of the wound is satisfactory. If it should be found on exploration of gunshot cases that suture of the nerve is not required, freeing of the nerve from scar may favorably influence regeneration. Nerves paralyzed by stab wounds should be sutured when primary treatment is given.

Exposure of peripheral nerves to obtain definite information of the lesion can be done with little risk to the patient or the nerve by those experienced in this type of surgery. The exposed lesion may be either partial or complete division of the nerve, or a neuroma in continuity. If the nerve is partially or completely divided, the indications for specific surgical treatment are clear. However, if a neuroma in continuity is present, expert surgical judgment may be required to decide whether the neuroma should be excised and direct suture made or whether the operation should consist merely of freeing the nerve from its bed of scar or pressure from callus formation. Obviously, if the muscles respond upon faradic stimulation of the nerve applied above the neuroma, neurolysis would be considered sufficient. Some idea of the regenerative possiblities of the paralyzed nerve may be obtained from the consistency of the neuroma, a firm resistant neuroma indicating an impermeable obstruction from intraneural scar. Excising of the neuroma and direct suture is required in such cases (Figs. 3 and 8). It was common practice in the Army hospitals of World War I, when attempting to make a decision as to whether the neuroma should be excised or simply freed from scar, to inject saline solution under the covering of the neuroma for the purpose of disclosing the

condition of its neural contents. On the whole, the investigation of the neuroma by all approved procedures often fails to give satisfactory information as to how much the scar formation will permanently obstruct regeneration. It is generally believed that it is best to perform a neurolysis in doubtful cases with later resection and suture if the neurolysis fails to restore function.

Divided nerves retract, leaving a considerable gap between the ends which later develop bulbous neuromas. Wide separation of the ends may result from too energetic débridement of gunshot wounds by those unfamiliar with anatomy of the extremity. In the writer's experience in the Army cases, there was considerable separation of the bulbous ends of the nerves at operation in the majority of cases (Fig. 2). It is highly desirable at the primary treatment of a gunshot wound when division of the nerve is recognized, that the ends of the nerve should be tied together to prevent further retraction and enable a more satisfactory suture at secondary operation. In a few favorable cases in which the nerve ends are easily approximated, a satisfactory suture may be done at the primary operation for disinfecting the wound. Extensive dissections of the nerve at this time should not be done.

The problems of nerve suture have centered largely about methods of approximation of the nerve segments without great tension after resection of the scar tissue. All the methods for gaining distance when the nerve ends are widely separated are well known and need only be mentioned.

The simplest method for gaining distance when the nerve ends are separated is to place the extremity in the posture that will provide the greatest relaxation of the nerve. This is particularly applicable to the sciatic nerve (Fig. 6), but is helpful to some degree in the suture of all peripheral nerves (Figs. 9 and 10).

Transposition of the nerve to a more direct course is sometimes necessary, especially in ulnar and musculospiral lesions with loss of nerve substance (Figs. 1 and 5). In transposing the ulnar nerve the trunk is removed from its position behind the internal condyle to a new bed on the flexor surface of the forearm. In the new position, flexing the extremity gives considerable relaxation of the nerve trunk. Transposition of the nerve is also useful in cases of traumatic ulnar neuritis, to protect the nerve from further injury. In transposition of the ulnar nerve, its branches to the forearm muscles should be carefully protected to prevent additional impairment although in extreme cases, with considerable loss of nerve tissue, it may be necessary to sacrifice certain branches of the ulnar to the forearm muscles in order to restore the more important innervation to the intrinsic muscles of the hand.

Gentle stretching of the nerve at operation will gain distance to a limited extent (2 cm.). In this procedure, more force should be used on the degenerated distal, than on the proximal, segment.

Whenever a considerable gap in the nerve trunk is disclosed at exploration, or a long neuroma in continuity requiring excision is exposed, it is most important to decide before excising the scar tissue from the nerve whether the healthy nerve segments can be approximated without excessive tension by one or more of the methods for gaining distance previously mentioned. If satisfactory approximation seems unlikely, the limb should be put in the optimum position for relaxation of the nerve and the neuromatous ends tied together with heavy silk sutures. Then over a period of 3 to 4 weeks the position of the limb may be

Fig. 4. a, Division of the ulnar nerve at the wrist with fracture of the ulna by shell fragments. Scar of incision as shown; b, dense scar involving the nerves and muscles; c, the dorsal branch of the ulnar has been completely divided and a large impermeable neuroma is shown on the palmar branch. After preparation of the nerve for suture, a gap of 4.5 centimeters was present and the ends could not be approximated; d, graft from musculocutaneous of the leg was used for transplantation; e, the grafts are shown in position. In small nerves such as the ulnar after its bifurcation, it would seem that autogenous grafts would have a definite field when direct approximation cannot be secured.

Fig. 5. Large lateral neuroma of the left ulnar nerve. a, Line of incision; b, exposure of the median and ulnar nerves; c, median nerve is intact; d, lateral neuroma involving so much of the nerve that it did not seem feasible to attempt to save the few fibers remaining intact. The neuroma was completely excised. The funiculi of the healthy nerve end after excision of the neuroma are shown; e, the nerve was removed from its normal bed and shifted to an anterior position to gain distance. The branches to the forearm muscles were protected in the transposition.

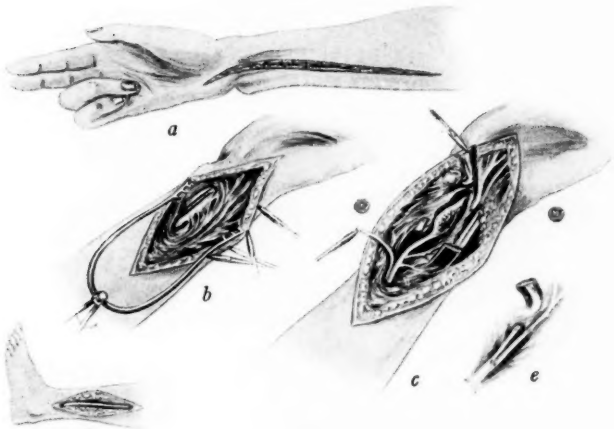

Fig. 4.

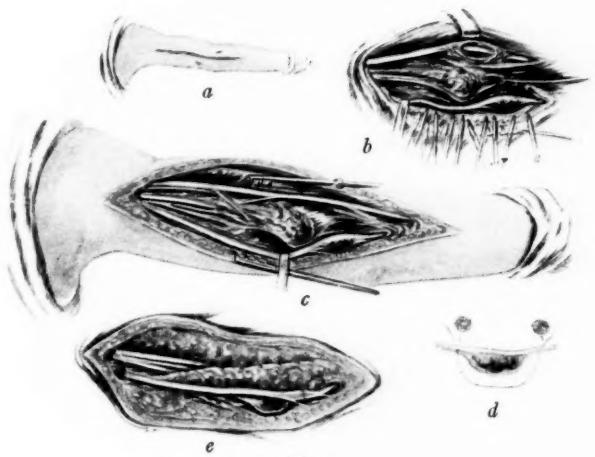

Fig. 5.

Surgical Treatment of Peripheral Nerve Injuries.—
Claude C. Coleman

Fig. 6.

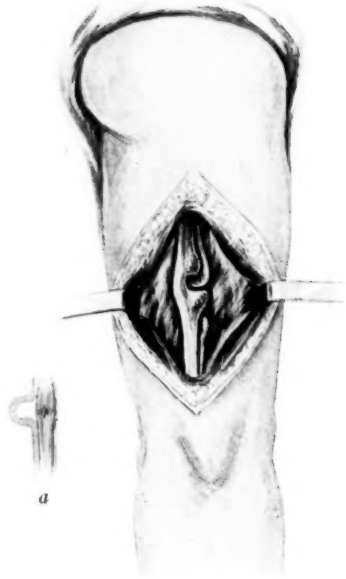

Fig. 7.

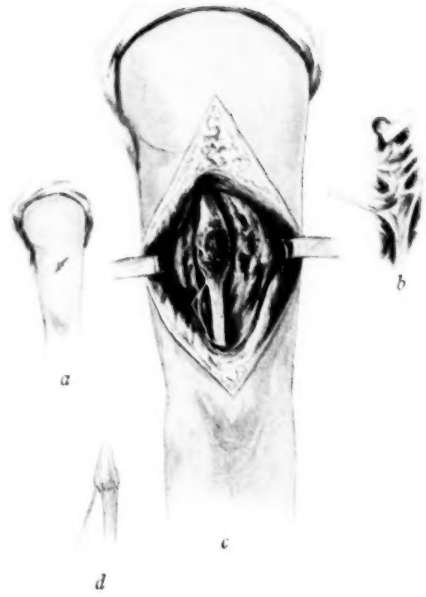

Fig. 8.

Surgical Treatment of Peripheral Nerve Injuries.—Claude C. Coleman

gradually changed to that which produces the greatest tension on the nerve. Thus the nerve may be lengthened sufficiently to permit excision of the neuromas and approximation of healthy nerve ends without tension. We do not believe that careful gradual stretching of the nerve impairs its recovery after suture. It is probable that the elongation of the nerve trunk under such circumstances is due to growth of the nerve segment as well as stretching.

In a long neuroma in continuity when it is obvious that complete excision of the scar would create a gap too wide for satisfactory approximation, only the central portion of the neuroma should be excised, leaving sufficient scar tissue at each end for temporary tension sutures for gradual stretching of the nerve. If it should happen that approximation of the nerve ends cannot be made without excessive tension after complete excision of the scar tissue and should gradual stretching then be found necessary, the situation would be most unfortunate because further loss of nerve tissue would result from passing traction sutures through the healthy nerve ends from which the neuroma had been excised.

Another procedure for reducing the gap between nerve segments is resection of one of the long bones. This operation has been most often applied to the humerus when more than one nerve is injured. Resection of the humerus to make possible direct suture of the median and ulnar nerves was done a few times in the Cape May series and it has been used by the writer in 3 cases in civilian practice. In the writer's opinion the operation has a definite field of usefulness but is rarely necessary and should be considered only when other less drastic methods for gaining distance have failed to bring about sufficient relaxation of the nerve.

Transplantation of nerves to overcome defects continues to receive much attention (Figs. 2 and 4). Animal experimentation provides histological evidence of the success of nerve transplants but this has had little support from clinical experience. Experimental transplantation of nerves was extensively investigated by Huber and his associates, Dean Lewis, Byron Stookey, and others in the Army laboratory authorized by the Surgeon General in World War I. The work of these investigators covered practically all phases of nerve regeneration from the experimental standpoint, and the published results are being confirmed by studies at the present time. The attitude toward the benefits of transplantation appears to be determined largely by whether the transplants are used in experimental laboratories or upon nerves of human beings. Generally speaking, surgeons have regarded the method as a failure. The functional results of nerve transplantation in the Cape May series so far as the writer knows were entirely disappointing. Not a single patient, examined by me, showed the slightest evidence of recovery of useful function. Perhaps the Tinel sign showed some evidence of down growing nerve fibers but this was all.

Robert Jones reported a large number of cases in which operations were carried out by transplantation, with 1 patient recovering function, a few obtaining partial recoveries

Fig. 6. High gunshot wound of the sciatic nerve. a, fracture of femur caused by the missile; b, exposure of the nerve below the dense scar; c, further dissection of the nerve and exposure of muscular branches; d, the nerve is dissected free from scar tissue. Appearance of a very large dense neuroma in continuity; e, a tension suture is placed through healthy nerve about 1 centimeter from each end of the neuroma. The neuroma is excised and direct suture made without tension after flexion of the leg on the thigh. This position is maintained for 2 weeks; f, line of incision for high lesions of the sciatic nerve. In lesions about the level of the pyriformis the tendon of the gluteus maximus is divided. This incision allows rapid exposure of the nerve and was first used by the writer in 1919.

Fig. 7. Partial division of sciatic nerve in the midthigh. The missile completely severed the external popliteal constituent of the nerve and produced a considerable defect in the internal popliteal division. In this case division of the sciatic into its two main branches was at a higher level than is usual. a, The neuromas have been removed and direct suture of both the external popliteal and the severed portion of the internal is done. The loop of the undivided portion of the nerve is shown. In sciatic lesions of this type, preservation of the intact portion during suture is more easily accomplished than in any other peripheral nerve.

Fig. 8. Gunshot wound of sciatic nerve. a, Scar of gunshot wound of upper thigh; b, beginning exposure of nerve, showing it surrounded by dense scar tissue; c, neuroma of the nerve is illustrated. The branch to the semitendinosus has been protected during the dissection. Excision of the dense neuroma left a defect of 3.5 centimeters; d, completed suture. The branch to the semitendinosus was sutured to the inner surface of the proximal segment. In this case two tension sutures seemed advisable.

Fig. 9. Division of left ulnar nerve by glass just above its bifurcation. Appearance of nerve 7 months after injury. Large neuroma developed in proximal segment. a, Resection of the neuroma leaves a gap of about 3 centimeters.

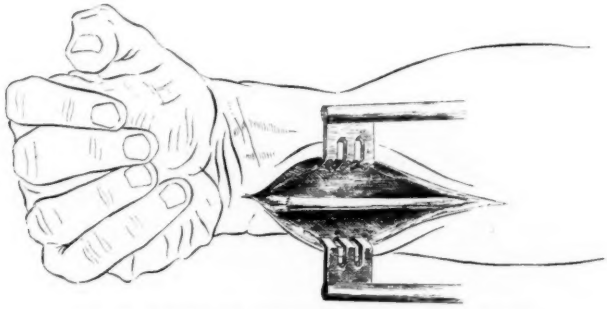

Fig. 10. Completed suture with hand in palmar flexion.

but most of the cases ended in complete failure.

Davis and Pollock acknowledge the promising result of experimental transplantation but state that the clinical results had been disappointing.

It may be that results of transplantation can be improved by the method advocated by Davis and Cleveland by later resection of the distal suture line of the transplant with resuture. This procedure has also been advocated by Bentley and Hill. We have seen no reports of this procedure in clinical cases. Such a resection of the distal part of the transplant was done by the writer in 1 case and resuture of the transplant was done (Fig. 2). Studies of the specimen showed penetration by the proximal axones into the transplant for a distance of about 2 centimeters. The appearance of the remainder of the transplant imbedded as it was in dense scar certainly gave no indication that functional recovery would take place. The interposition of small autogenous cable transplants suggested by Huber and his associates seems inadequate to restore the continuity of the larger peripheral nerves in man. Later exploration of such transplants is likely to show in most cases impermeable barriers of scar tissue.

We believe that there is a field for nerve transplantation in defects of small nerves such as the facial or the nerves of the hand. In small nerves the distance would likely be short, and this would be a matter of considerable importance to successful regeneration through the transplant. Autogenous transplants may be taken from other nerves of little importance. The success of transplantation of small nerves has been proved by both clinical and experimental results.

When restoration of nerve function is manifestly impossible, and this may be the

case in lesions of the posterior interrosseous and the external popliteal, a substitute for nerve action may be found in transplantation of the tendons of normal muscles to take over the action of those which have been denervated. A familiar example of such transplantation is in the use of the flexor carpi radialis and ulnaris to the common extensors of the fingers and extensors of the thumb to produce extension of the hand, fingers and thumb when the posterior interosseus cannot be repaired.

Certain procedures for nerve repair, such as nerve flaps, nerve implantation and direct implantation into muscle, enjoyed a brief use before the futility of such procedures was recognized. A very ingenious proposal for reuniting divided nerves was suggested by Young and Mediwar in 1940 from experiments carried out in animals. This method consists of joining the nerve ends by a coagulated plasma cuff. So far as I know, this procedure has not been used clinically and it would seem to have definite limitations because of the low tensile strength of the cuff which makes it unsuitable for clinical cases. Perhaps a combination of plasma cuff and suture might offer some advantages in certain cases.

It is universally agreed that direct suture of healthy nerve ends is the only satisfactory method of repairing divided nerves. The wound should be well healed although Ballance and Duel appear to have found infection no obstruction to regeneration in the grafting of a facial nerve following mastoid operation.

The technique of nerve suture has received considerable attention and at the present time it is essentially that generally used in the first World War. We have seen in the literature only a few variations from this technique and these apparently are not of sufficient importance to affect materially the results of suture. Practically all writers on nerve suture recommend exposure first of the nerve trunk above and below the scarred area with later approach to the lesion itself. A tourniquet is not only unnecessary, but it may produce further serious damage to the nerve and muscles of the extremity.

The writer has always used fine interrupted silk suture for approximation of the epineurium with one No. 00 plain catgut or fine silk intraneural tension suture passed through the nerve about 1½ to 2 centimeters from the ends to hold the segments in apposition while the epineurium is being approximated and to maintain accurate approximation after suture (Fig. 13). The relaxation suture is unnecessary when there is no loss of nerve substance as in stab wounds operated upon before retraction takes place (Fig. 11).

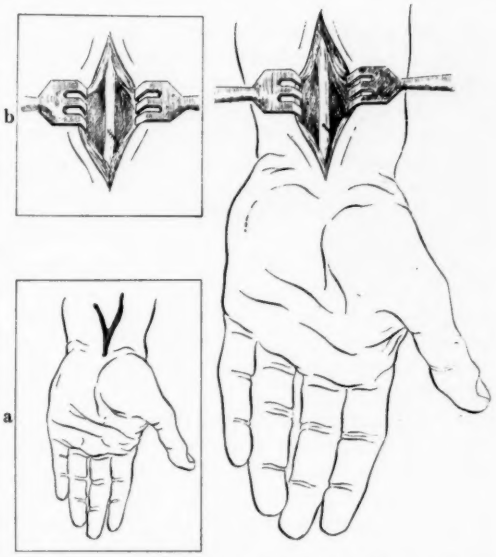

Fig. 11. Partial division of the left median nerve by glass. There is practically no loss of nerve substance. a, "Y" shaped laceration of the wrist. No tendons were divided; b, suture of the divided portion of the nerve performed a few hours after injury.

Recently fine steel wire sutures have been proposed by Colonel W. V. Cone at the Canadian Neurosurgical Hospital, Basingstroke. Other surgeons, notably Lt. Colonel R. Glen Spurling, use tantalum wire instead of silk as a suture material. It is claimed by those who have used tantalum that it is less irritating than silk and a further advantage of tantalum is that the integrity of the suture line may be demonstrated by later x-ray examination. We think the second point is of some importance, but we have not been convinced that tantalum has advantages over silk in so far as the functional results obtained are concerned.

In the approximation of nerve segments for suture, it has always seemed important to the writer to maintain the normal alinement of the nerve as nearly as possible. In order to prevent rotation of the nerve during suture, we have placed fine silk knots in the epineurium in the same plane, above and below the level of the lesion before the nerve is removed from its bed of scar tissue. The appearance of the nerve ends may sometimes furnish information as to the normal alinement. Therefore, the nerve ends should be carefully inspected for corresponding blood vessels in either segment to indicate the correct pattern of the approximated nerve. The importance of preventing rotation is, perhaps, greatest in those nerve lesions in which little of the trunk has been lost. Because of the rather rapidly changing topography of the nerve trunk, torsion of the nerve segments is of less importance when a considerable gap exists.

The dissection and manipulation of the nerve trunk in freeing it from scar tissue should be done with great gentleness, and much care is necessary in some cases to avoid injury to important branches imbedded in dense scar.

In preparation of the nerve for suture, scar tissue is removed from the neuromatous ends in thin serial sections with a razor blade held in a hemostat, each section being carefully inspected for scar tissue and nerve fibers. As the section approaches healthy nerve, bleeding from the nerve increases and the funiculi become apparent. It seems unnecessary to use any chemical to identify the nerve fibers thus exposed. They should be recognized with the naked eye before the nerve is considered properly prepared for suture. The end of the nerve when prepared for suture should be smooth with no irregular projection of the funiculi. Hemorrhage from the nerve ends may be controlled by gentle pressure with wet cotton pads or temporary application of a muscle graft. Accumulation of blood between the sutured segments militates against functional recovery. The epineurium is carefully approximated with interrupted sutures of arterial silk after complete hemostasis of the nerve ends. The originally placed intraneural suture should then be tied with sufficient tension to relax the intervening nerve trunk and bring into accurate apposition the cut surfaces of the nerve ends. In very small nerves such as a branch of the facial, an epineural suture may be impracticable. Careful end-to-end approximation of the nerve segments with a fine through-and-through suture is usually sufficient in such cases (Fig. 13).

Various types of material have been used to protect the sutured nerve from invasion by scar tissue. Spurling recently has been wrapping the line of suture with tantalum foil. This has not been used sufficiently long to determine its effect on regeneration. In the writer's opinion, it is doubtful that any nerve wrapping accomplishes the purposes for which it is intended. It is rather widely believed that instead of protecting the nerve from scar tissue, wrapping materials often increase scar formation. In most cases complete hemostasis of the wound and placing the nerve in a muscle bed will assure minimal scarring about the nerve. In certain cases in which the nerve has been mobilized for some distance, or when the soft tissue support has been extensively destroyed, it is possible to give some protection to the nerve by placing a well vascularized pedicle of fat beneath it. Oozing from small vessels may be controlled by coagulation with the electrosurgical unit, and this materially shortens the time of operation.

The repair of partial defects in peripheral nerves is most easily done in the sciatic in the middle portion of its course where one of the main constituents may be divided without injury to the other (Fig. 7). In such cases the repair of the nerve trunk is effected by separation of the nerve trunks above and below the lesion to prevent excessive angulation of the undamaged companion nerve, by suture of the divided trunk. The difficulties of repairing a partial lesion are greater in other nerves in view of the fact that a single nerve trunk must be split longitudinally above and below the lesion in order to approximate that portion of the nerve which has been severed. Thus a certain amount of damage to the nerve trunk above and below the lesion is inevitable, and it is better in cases when the lesion is almost complete, to divide the nerve entirely and follow the technique of direct suture.

A rather frequent type of injury which should be mentioned, though not usually requiring operation, is injury of the musculospiral nerve in fracture of the humerus. A temporary paralysis is not uncommon, but spontaneous recovery occurs in a large majority of cases. Operative reduction and fixation of the fracture should be done carefully to avoid further damage to the nerve. In some of these cases, forcible traction from displacement of bone fragments and subsequent scar tissue formation may damage the nerve over a considerable distance. The nerve may be scarred, flattened and attenuated, and satisfactory operation upon the nerve may be a procedure of great difficulty.

Injury to a nerve trunk by severe traction presents rather difficult problems in treatment. It is unusual for the nerve trunk to be completely divided by the traction force but injury to the nerve may extend over a considerable distance, making it difficult if not impossible to determine how much of the nerve has been damaged. Nerve traction injuries are not uncommon in external popliteal nerve.

Following suture of a nerve, the extremity should be kept in the proper position for the maximum relaxation of the nerve and this position maintained by a plaster cast for 2 weeks. We believe that a longer period of plaster fixation not only is unnecessary but is detrimental in that it interferes with physical therapy. We have never had a suture line rupture except on one occasion during operation when the limb was dropped by an inattentive assistant.

The care of the paralyzed extremity is of greatest importance both before and after operation. The effects of massage, electrotherapy, and passive movements have not yet been agreed upon. Massage is generally resumed after the 3d postoperative week, and the writer believes it to be helpful. Moreover, it produces a better mental attitude in patients, many of whom will be under medical care for months. The effects of vitamin deficiency in its relationship to regeneration of peripheral nerves has been considered and deserves further investigation. The fact that nerve tissue in general may suffer in vitamin deficiency naturally leads to the consideration of the effects of such deficiency in the recovery of nerve lesions.

Fig. 12. Incision for exposure of high lesions of the musculospiral, median, and ulnar nerves. It is often necessary to divide the tendon of the pectoralis major muscle. The incision is well away from the axilla. Should approximation of the arm to the chest be necessary to relieve tension on the nerve, the skin incision is still accessible and may be readily sutured.

The splinting of paralyzed muscles is a very important part of the treatment of peripheral nerve lesions in combination with the surgical repair as well as in many cases when surgical treatment is not required. This important adjunct is often omitted in civilian practice. The splinting should be continued until muscle function is sufficiently restored to prevent the stretching of the paralyzed muscles. The most favorable nerves for splinting are the musculospiral and anterior tibial. The splints devised by R. C. Buerki at Cape May for these two nerves incorporate all the requirements of successful support and have been used by the writer in preference to all others.

In cases following sciatic nerve suture, a splint, hinged at the knee, may be used which will permit flexion of the leg, and at the same time, limit extension sufficiently to prevent excessive tension on the suture line. Such splints are easily applied and were used in the cases of the first World War.

Peripheral nerve injuries in civilian practice requiring operation are most often caused by sharp instruments and fragments of glass with little loss of nerve tissue or destructive associated injuries. With adequate primary treatment there should be no infection of the wound. Under such conditions the best possible functional results should be expected.

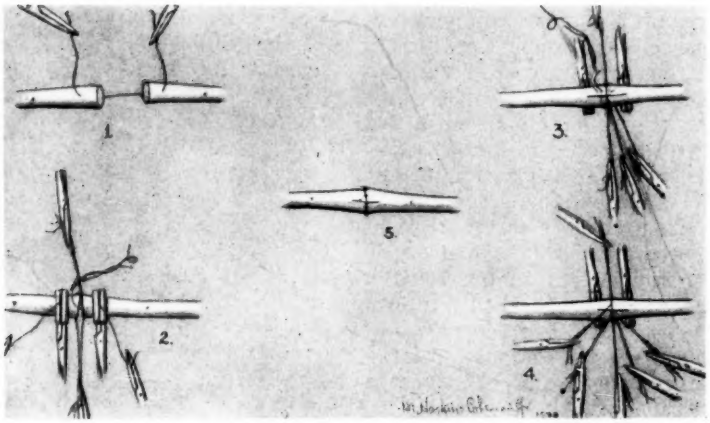

Fig. 13. Technique of direct nerve suture. 1, Silk knots are placed in the epineurium of each nerve segment to indicate proper alinement. A tension suture of fine silk is used for approximation of the nerve ends during suture. 2, By slight traction on the two ends of the tension suture the prepared ends of the nerve segments may be held in apposition. Each end of the tension suture is then clamped with a rubber covered mosquito forcep, close to the nerve to maintain approximation. The epineurium is carefully approximated for one-half the circumference of the nerve with arterial silk sutures. 3 and 4, Rotation of the mosquito clamps will permit the suture to be completed. 5, The completed suture. The tension suture is tied after all epineural sutures are placed. Very gentle traction should be used in tying the tension suture to avoid damage to the nerve trunk.

Although voluminous literature of war injuries of the peripheral nerves accumulated in the years from 1919 to 1924, subsequent nerve injuries of civilian life have apparently received little attention in current medical literature, despite their importance and the almost ideal conditions surrounding the treatment of such lesions.

In actual practice the treatment of nerve lesions resulting from transportation and industrial accidents in civilian life is far from satisfactory chiefly because of inexperience of those who attempt to carry out the primary treatment of the wound and the failure to make adequate use of physical therapy in the period of regeneration. In some cases, tendons are sutured and the skin closed without investigation of the nerves in the field. One must conclude that the surgical treatment of lesions of peripheral nerves produced in civilian occupations has not benefited to the degree which should have been expected from the information gained in the study and treatment of nerve injuries in the first World War. A common peripheral nerve injury seen in private practice is one just above the wrist involving the tendons and the ulnar or median or both of these nerves. This disabling injury is one of vast importance to the individual, and too often the treatment of such a wound, requiring, as it does, high operative skill, is entrusted to some inexperienced member of the house staff. Secondary operations not infrequently disclose suture of the median nerve to the palmaris longus or the ulnar to the flexor carpi ulnaris tendon. Such errors are deplorable.

The diagnosis of division of a nerve can be made unequivocally when a stab wound in the region of a nerve is followed by immediate paralysis of the nerve. If this proof of nerve division is kept in mind by those without special training in neurological surgery, divided nerves would not so often escape detection in the primary treatment of the wound, but it seems too much to expect that the differentiation will be made between tendons and nerves by inexperienced operators. The associated division of the tendons in lacerations above the wrist may mask the symptoms of a nerve lesion and also seriously impair the

functional success of nerve suture. One often sees lacerations in the region of the parotid gland sutured without any effort having been made to find the facial nerve at the primary operation even though the patient was unable to close his eye or retract the corner of his mouth. Identification of the nerves at the time of primary treatment is much easier than it is later on when scar tissue has developed.

It is almost incredible that there should be so little unanimity of opinion as to just how much may be accomplished in the restoration of function of peripheral nerves under ideal conditions in the human being. The improvement of nerve function by direct suture, often described as satisfactory recovery, is a matter of common observation, but no criteria of recovery have as yet been formulated from which a clear impression can be obtained as to what permanent residual effects persist following nerve interruption. In other words, the terms which have been used to express the end-results of suture of divided nerves convey no uniform meaning. They are, therefore, of little value in estimating precisely the degree of functional recovery following nerve suture.

It is obvious that the final results of nerve suture are impaired by severe associated injuries or when suture is long delayed, but even in those cases in which the nerve lesion is the only important one, as in many cases of civilian practice, and the nerve is sutured at the primary treatment of the wound, there are certain residual effects of nerve interruption which are permanent. Inherent defects of regeneration of nerves have been discussed by Stopford, Cajal, Ford and Woodhall and others who have called attention to misdirection of downgrowing nerve fibers from the proximal segment. Accurate alinement and suture will not prevent straying of these fibers. Many regenerating fibers intended for one domain of the nerve field may find their way into another to the confusion of the normal nerve pattern. Because of the excessive number of regenerating axis cylinders, undoubtedly many will find appropriate pathways and reach their proper terminals, thereby restoring function of the nerve considerably.

Head, in his classical experiments on the cutaneous branch of the musculospiral nerve, in his own arm, found persisting confusion in discriminative perception of certain types of peripheral stimuli.

Regeneration after anatomical division of the facial trunk is invariably followed by mass movements. The best explanation of this is that straying of regenerating fibers binds the muscles of expression into a functional unit incapable of the dissociation of action essential to emotional expression. It is very doubtful that re-education has any beneficial effect on such a permanent distortion of the nerve pattern, and it is highly probable that too much effort at re-education may make matters worse.

Perfect results in the treatment of peripheral nerve lesions may never be obtained, but this in no way should detract from the importance of continued study of the whole problem of nerve regeneration and search for the best methods of treatment.

An unrivaled opportunity for the advancement of knowledge of peripheral nerve injuries was lost after World War I through the failure to have the end-results of treatment of the Army cases assessed by those competent and interested in such lesions. After soldiers were discharged from the Peripheral Nerve Centers the subsequent care was assigned to other organizations. No satisfactory followup system was instituted. Valuable as was the information accumulated from the study of approximately 4,500 nerve injuries by competent personnel, the investigation lost most of its worth through the failure to determine the ultimate results of treatment. The writer must admit that with few exceptions, he received only impressions as to the results of the Cape May and Staten Island series. It is hoped that such an opportunity will not again be lost in dealing with nerve injuries in the present war, but that some effective plan for periodic surveys of these cases for at least 3 years after surgical treatment will be put into operation with a published final report as to the results of treatment.

The criteria of recovery of peripheral nerve injuries should be standardized with application of appropriate criteria to each individual nerve. The extent of functional disability following adequate surgical treatment of nerve

injuries depends on the nerve involved. It is generally believed, and this has been the writer's experience, that the musculospiral leads in the degree of recovery following suture. There are several reasons for this, one being that the nerve is predominantly motor, serves a coarse function and in its action as a stabilizer of the hand, makes possible normal motor function of the median and ulnar.

The degree of permanent disability in the hand following division of the median or ulnar nerve will depend to a considerable extent on the occupation of the individual. Work not requiring discriminatory or fine movements of the hand may be done with little handicap, while other occupations such as typing would be difficult, if not impossible. Obvious limitations of functional recovery are imposed by changes which take place in the denervated muscles, particularly in the intrinsic muscles of the hand. Atrophy of varying degree is an inevitable result of muscle denervation regardless of the time suture is done or measures instituted to prevent its development. This atrophy of hand muscles remains a permanent stigma of denervation following median and ulnar lesions. Periarticular fibrosis of the fingers, especially in severe partial lesions, frequently contributes to permanent impairment of function in the hand and mars the results of otherwise successful nerve suture.

Further progress in the treatment of peripheral nerve lesions will undoubtedly result from the experiences of the present war through prevention of infection which will permit early exploration of the injured nerve by experienced neurological surgeons. Unless, however, precise criteria for evaluating the end-results of surgical treatment of lesions of individual nerves are formulated with systematic postoperative supervision, carried out by competent groups for at least 3 years, the results of operation on peripheral nerve lesions will remain largely a matter of impressions rather than precise knowledge.

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TREATMENT OF WOUNDED IN THE COMBAT ZONE

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UPON the walls of the Medical Field Service School at Carlisle Barracks, there is inscribed the basic purpose of the medical officer of the United States Army, "Conserve the Fighting Strength." Every effort of the medical department is bent, in time of war, toward the fulfillment of the principles expressed in this decree.

War has been defined as a traumatic epidemic. World War I was strictly a trench conflict where wounds were sustained in the presence of highly manured soil where gas gangrene was an ever present menace. The present conflict involves motorized, mechanized warfare with mobile fighting where the principle of taking the doctor to the patient[1] and not the patient to the doctor is in vogue.

Generally speaking, wounds in time of war come primarily from bullets which, in the present conflict, have a higher velocity with greater explosive action than we saw in the last conflict. The high velocity bullet does not, as a rule, carry clothing into the human body but that bullet, in spite of its high velocity, is unstable if it meets with some obstruction and is apt to tumble or fall over in its course of flight within the body when its nose or point strikes bony resistance. Various types of wounds can be expected from different types of bullets. The German ammunition belt examined from captured German planes, has been shown to have five types of bullets placed in rotation on the belt in the following order: ball ammunition, armor piercing bullet, armor piercing bullet with tracer, armor piercing bullet with incendiary, and explosive bullet. This analysis of German ammunition as published by the British Army shows, immediately, the various types of bullets that are productive of wounds of war.

Bursting shrapnel produce lacerated wounds that frequently carry particles of clothing in the course of their transit. Also, bombs fracturing in the presence of buildings complicate the situation frequently by inflicting injuries from flying glass.

The bayonet wound is, of course, rare as compared with that from bullets and bombs but we do have bayonet wounds from hand to hand fighting. This is particularly true of the Japanese who train their troops to charge after throwing hand grenades. The Japanese hand grenade, less powerful than the German or our grenade, stuns rather than destroys. The Japanese soldier follows up the grenade attack with the bayonet. Whether the wound be of bullet, shrapnel, or bayonet, it is considered infected.

First aid to the wounded on the field is specific and limited in its scope. It involves the use of a simple dry dressing, the control of hemorrhage, and the application of a tourniquet when necessary. Stress is placed upon the importance of applying the tourniquet at the most distal point and making a note to that effect on the forehead of the soldier, or on his casualty card. This is essential, for the man being returned to the rear may be unconscious and the presence of a tourniquet overlooked unless properly marked. All chest wounds are closed as an emergency measure. Except in head injuries, pain is controlled with large doses of morphine sulfate, care being taken to mark its administration on the casualty card of the injured soldier. The old rule of splinting them where they lie applies in war surgery and a bayonet or gun stuck in the ground as a guide is an essential part of the first aid technique which makes the location of a wounded man apparent to the litter bearers.

Evacuation of the wounded is based upon a general principle as illustrated in the enclosed diagram (Fig. 1). It is recognized, and must be considered as paramount, that a basic

Presented before the War Sessions of the American College of Surgeons, Pittsburgh, Pennsylvania, March 10, 1943, and Richmond, Virginia, March 19, 1943.

[1]Lull, Brigadier General George F. J. Am. M. Ass., 1943, 121: 538.

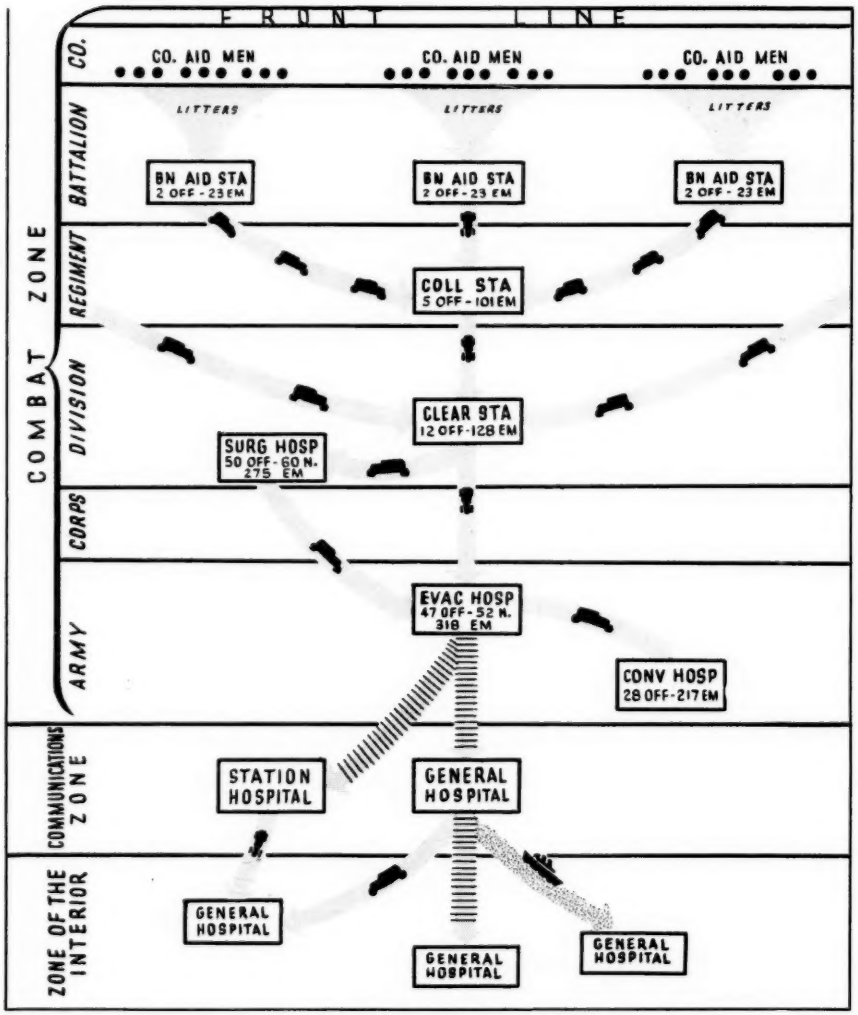

Fig. 1. Chain of evacuation of wounded.

scheme of evacuation is essential to act as a foundation for a compromise or changed plan in the presence of conflict. In other words, the ideal scheme of evacuation as worked out and demonstrated may have to be considerably modified in time of war. However, the general principles of the ideal scheme must form the basic background for proper evacuation and treatment of the sick and wounded.

Treatment in the collecting, clearing, evacuation, or surgical stations must follow a thoroughly understood principle. The chief or senior surgeon of all of these units should act as liaison officer deciding the priority for operation, observation, evacuation, or treatment for shock of all wounded men. The proper classification as to the treatment of all wounded men is of the utmost importance.

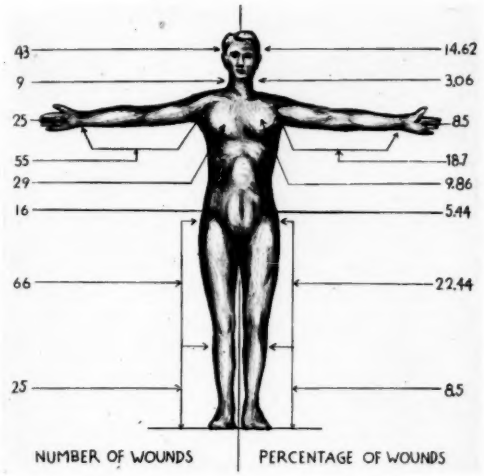

Fig. 2. Wound location chart for armored units in the Middle East.

It is an accepted fact that over 50 per cent of wounded men fall in the so called lightly wounded category. The division of men lightly wounded and those seriously wounded should be the responsibility of the senior surgeon. Lightly wounded men can be treated at the rate of approximately 10 cases per hour, whereas a single seriously wounded man requires at least 1 hour for his treatment. The senior surgeon must direct the priority or right-of-way for the disposition of injured men. Restoration to active service of as many men in the quickest possible time is imperative. More than this, time lag must be eliminated if possible, keeping in mind the so called golden 6 hour period. The guiding hand of the senior surgeon is an essential and necessary duty which is of the utmost importance.

The surgical approach to the wounded is preceded by x-ray examination which has, in recent years, been standardized by Colonel DeLorimer who has established, in field units, a biplane marker with an orientation device whereby the exact location of foreign objects within the body of the injured soldier are determined by triangulation. The English, in their statistical reports, state that they have removed 95 per cent of all foreign bodies in their gunshot and shrapnel cases.

Fig. 3. American modification of English method of evacuating injured men from tanks. Web belt slipped up under armpits.

Prior to surgery all wounds are cleansed with soap and water, every effort being made not to wash dirt into the wound. The use of nonirritating cleansing was popularized after Dunkirk when it was found that men remaining in salt water over long periods of time were found to have very little infection in their wounds. A wide incision including the deep fascial layers, débridement, removal of foreign bodies and fragments of clothing, with the dusting of crystal sulfanilamide and the application of vaseline gauze dressing completes the wound toilet. No suturing and the use of immobilization by casts in extensive soft tissue wounds as well as fractures is advocated. Casts should not be applied to men who are

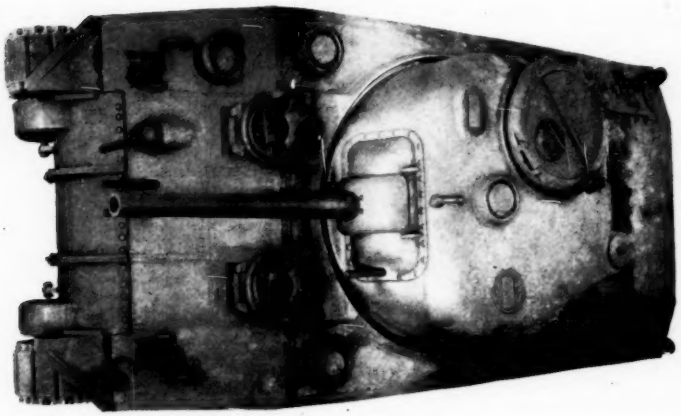

Fig. 4. American tank "buttoned up" demonstrating size of manholes and difficulties of evacuation for wounded.

Fig. 5. Disabled driver within a tank. Restriction of space makes evacuation of wounded extremely difficult.

to be transported by water where ships are subject to sinking by enemy action. A cast absorbs water when men are thrown into the sea and acts as an anchor. Therefore, Thomas, Cramer wire and wooden splints should be used under these and appropriate circumstances.

Emergency early surgery of wounds involving injuries to nerves calls for the approximation of the nerves with a single suture to await secondary repair. Bone fragments should be removed from compound fractures. All joint cavities should be closed, the soft parts being

left open. Chest and head wounds call for débridement and closure.

As a matter of comparison, I quote from a letter written to my father during action on the Champaign sector in World War I:

"Our work usually goes on as follows: Before a drive is contemplated word reaches us through rumor or official notice. If either of these fail, the barrage put down for several hours before an attack is so severe as to be unmistakable With this warning, everything is gotten ready. The wounded are gathered together by stretcher bearers and taken to the regimental aid stations. The function of these organizations is threefold: they examine every wound and control hemorrhage by first aid means; secondly, give a prophylactic dose of antitetanic serum, and lastly, and most important, divide the cases into transportable and nontransportable groups. Nontransportable cases are those requiring immediate attention and are sent at once to the field hospital by means of trucks, etc. Our field hospital (clearing station) receives wounds of the head, chest, abdomen, and serious extremity complications. Transportable cases are sent back to the evacuation hospital. Thus the field hospitals (clearing stations) get fewer and more serious cases whereas the evacuation hospitals do more work of a less serious character. Consequently the average mortality of a field hospital ranges about 10 per cent and the evacuation hospital, 5 per cent. This may be said to be an excellent average, in other words, a minimum.

"A case of the nontransportable group usually passes through the following stages. He is severely wounded and remains where he falls for a varying period of time. Exposure, lack of food and water, combined with pain and a rough ride, add the element of shock. These cases, if operated upon at once, invariably die, so that they are placed in a shock ward, stimulated, warmed up until their condition is improved and their chance of recovery enhanced.

"Head injuries are usually left alone except for débridement unless active hemorrhage is going on with signs of cerebral pressure.

"Chest wounds, which of their very nature are serious, are usually treated by simple closure. Machine gun wounds and small shrapnel penetrations are closed after débridement. These openings in the chest are closed at once at the first aid stations without anesthesia, for if allowed to remain open they produce the so called mediastinal flutter which, in turn, results in severe shock.

"Wounds of the abdomen of course call for immediate laparotomy and repair. Most cases will not permit of intestinal suture and an artificial (temporary) opening is usually advisable. Every case of intestinal anastomosis done in this hospital has resulted in death.

"Severe extremity wounds are treated by amputation or repair by débridement. The circular method of amputation is advised.

"War surgery permits of radical risks. Operating time is a most important element and forty minutes is the average maximum period allotted. Cases brought in here and kept on the table for over an hour will die.

"The average case with multiple small wounds shows much more shock than many of the seriously wounded."

Although no statistics are as yet available, all information points, in our present conflict, to a mortality rate under 3 per cent.

Burns are playing a large rôle in the traumatic epidemic of this war. Burns are undeniably wounds, should be treated as such and we, as surgeons, should apply the fundamental medical principles of wounds to burns. The flash and blast burns produced by a wave of flame pressure from bombs and torpedoes are now well known. This pressure wave of fire occurring on shipboard, and frequently on land, is accompanied with such force that it often knocks men off their feet. Interesting enough, evidence of this is shown by the fact that the back of the scalp of sailors subjected to blast burns, is entirely bald where the hair and scalp has come in contact with the deck. The metal deck is so heated by the blast of an exploding bomb or torpedo that it will burn the unprotected parts of the body upon contact. Bomb blasts have both a pressure and a suction wave. Pressure from bombs produces pulmonary injury if an individual is close enough to receive a force of a hundred pounds per square inch. Carbon monoxide poisoning must always be considered a possibility in the close proximity of a bursting bomb.

A new type of burn has come into the picture in this war; namely, phosphorous burns. These burns are produced by incendiary bombs and tracer bullets. The burn gives a grayish white reaction which many times produces vapor arising from the wound. This type of wound is extremely painful, without blistering, has a prolonged period of healing, and tends to become septic.

The therapy of burns, together with the various protective and healing agents advocated, indicates only too well that the final word has not been said in the treatment of this condition. All agree with the theory of treating the patient first and the burn second. There is no controversy in the use of morphine

to control pain, plasma in the presence of shock, and oxygen, especially in blast burns, to combat anoxemia. In the local treatment the fundamental principle of considering a burn a wound has become universally accepted. The use of masks, rubber gloves, and sterile gowns by nurses and doctors in dressing burns is imperative to guard against infection. Débridement, with soap and water, under morphine sedation, unquestionably gives the best result.

Controversy still exists in the use of the tanning methods formerly in vogue before the war began, and which received tremendous impetus at the Pearl Harbor incident. An eschar artificially produced is known to injure the epithelium of the skin and frequently nurtures infection with disastrous results, especially to the flexor surfaces of the body, the face and the genitals. On the field of battle, when tannic acid is applied locally to men later transferred from the forward positions to the zone of interior, infection has frequently developed and spread under the eschar, producing a serious and irreparable final outcome. The constrictive effect of the tanning eschar often results in the loss of tissue of the nose and the top of the ears. It also frequently interferes with the circulation of the extremities.

It is a reported possibility that tanning may have a toxic effect on the liver but the final constrictive effect of the tanning processes causing further injury to the epithelium, plus the danger of infection which results in contractures, has condemned this method of procedure so far as military surgery is concerned. The same rule applied to other tanning methods such as the triple dyes and Pickrell solution.

Because of this entire situation the Army has published a War Department directive advising the use of boric acid ointment or sterile vaseline supported by the pressure bandage. This method of treating burns was popularized during the recent Boston fire catastrophe and since has proved to be most effective. In time of war simple boric acid or sterile vaseline gauze may be applied with pressure bandages and allowed to remain on for a period of 10 days before they are removed. The sulfa drugs should be administered orally or intravenously in association with the pressure bandage method of treatment. In this connection, it has been demonstrated that the serum removed from burn blisters contains the same amount of sulfa concentration as the circulating blood. Therefore, it is quite apparent that the controlling influence of the sulfa drug is taken to the site of the burn through the blood stream whether the drug is given by mouth or applied locally. The use of sulfa drugs incorporated in an oil base of 6 per cent sulfanilamide or cold cream and lanolin makes an ideal ointment for the local application to burns and has received excellent results in the hands of those men who have used this type of treatment.

Equally good results can be obtained by the application of a simple boric acid ointment, vaseline or sulfa incorporated oil base dressing to the face, with or without pressure bandages. Although it is advisable to débride contaminated burns at the clearing stations, débridement can be eliminated and the ointment applied immediately to the burned surface. Men, when it is possible, should be encouraged to return to duty with instructions to have the burn redressed in a period of about 10 days. Redressing is best done under water so as to eliminate pain.

Finally, in its definitive treatment, teams of men specially trained in the care of burns should be established. Burned soldiers are helpless, cannot eat or dress themselves, and need a great deal of understanding and consideration. It has been noted that the skin surfaces, upon healing, are especially sensitive and that men will go through the wards holding their hands up in the air to avoid irritation. To help this situation olive oil can be applied to the skin. It is also very useful to fit these patients with gloves to protect the sensitive skin until it becomes hardened to the external atmosphere. Obviously, early skin graft is indicated in all third degree burns.

Burns involving the mucous membrane of the nasal pharyngeal surfaces frequently require tracheotomy in their treatment. This should be borne in mind in addition to the use of oxygen for this type of burn.

More recently the use of therapeutic penicillin has been advocated in the treatment of burns in individuals found to be resistant to the sulfa drugs.

The treatment of the phosphorous burn calls for immediate emersion in a dilute alkaline solution or in water when an alkaline solution is not available. Application of 1 per cent copper sulfate will blacken the phosphorus so that it can be seen and removed with forceps. In the absence of copper sulfate the phosphorus may sometimes be found by its vapors or by taking the patient into a darkened room where the phosphorous is fluorescent. Oil or grease should not be applied to phosphorus burns.

The basic background of this war is mechanization but mechanization must have human guidance and soldiers find themselves subject to all the hazards incident to mobile warfare. The tank with its armor protected body is a potential force of concentrated fire control. Its metal chassis filled with a combustion engine, ammunition, batteries, radios and wires, etc., has no resistance to heat and cold. Experience has shown in desert fighting that tank temperature is made bearable by the circulation of air within the tank caused by the revolving engine fan. This accounts for the remarkable situation that has been amply demonstrated in the British fighting where few cases of heat prostration have been reported in tank divisions. A tank, even though at a standstill, is entirely bearable as long as the air is kept in motion by a running engine.

Men afflicted with claustrophobia have no place in tank warfare. A closed unit, doors are now built in the floors of tanks to provide emergency exits. These escape doors in the floor, plus the normal avenues of escape through the manholes, provide ways for immediate evacuation.

Men who suffer from dust allergy are eliminated before entering the war zones. Tanks create a great deal of dust not only with their caterpillar tracks but also from gun bursts.

Our older tanks that were bolted together proved to be a definite hazard. A missile striking the tank but not penetrating its armor, transmitted its force to such a degree that the boltheads were broken loose inside the tank to become secondary projectiles. Welding has taken the place of bolts and has streamlined our tanks so that angles and flat surfaces have been pretty well eliminated. This rounding or streamlining of the tank has also encouraged ricocheting of projectiles rather than presenting a flat surface for their direct contact.

A terrific amount of heat and force is generated by a projectile striking a tank. This energy is transmitted directly and may result in flaking or chipping of metal or paint within the tank, burning or injuring the tank crew, and it may even ignite inflammable material.

The evacuation of wounded from tanks in time of war is a definite hazard, although this situation is not as serious as it might at first appear. The English have shown that about 90 per cent of tank crews evacuate themselves. It is an amazing fact that a seriously injured man will often get out of a disabled tank, either alone or with the help of his companions. The fear of known danger is so great that mental reaction overcomes physical disability. This leaves approximately 10 per cent of the crews to be evacuated by the medical department, a problem which frequently involves great difficulty.

Crews, in evacuating tanks, must seek ground protection rather than tank protection although the human reaction is to seek shelter behind some object. The tank is always a target for enemy fire. It will be fired upon even though disabled. Upon striking the tank, projectiles frequently fracture and their fragmented parts are thrown in every direction. The English have found that at least one-third of tank crews are injured when caught near their tanks. Therefore, experience has shown that ground protection is far safer than tank protection.

In the presence of enemy fire, evacuation of disabled, wounded men from tanks becomes imperative and necessarily must be done as quickly as possible. It is pretty well agreed that the quickest and surest way of getting a wounded man out of a tank in a hurry is to draw a half-hitch around his feet and extract him by the inverse method. Many modifications and various methods for the evacuation of wounded have been established by both the

British and American Armies. To facilitate evacuation and to control pain, morphine in ready to use "syrettes" is supplied to all members of our tank crews. The English go a step further when evacuating seriously wounded soldiers by using chloroform incorporated in gauze to eliminate the problem of pain and discomfort.

Modern warfare with its quick, brutal destruction on a mass scale involving speed, force and endurance, has called upon the military surgeon to use his initiative and resourcefulness in a resilient, aggressive manner. Mobile warfare has been applied to the evacuation of the sick and wounded so that the airplane as well as the motor vehicle, is responsible for their rapid transportation to hospital centers. This, with early treatment, plasma, and the sulfa drugs, in part accounts for the remarkably low mortality rate of the present war. In a former paper[1] I stated and still maintain, that the basic reasons for the success of the medical department of the United States Army has been superior leadership with the preliminary medical training that has qualified men through the various specialty boards, the American College of Surgeons, and the American College of Physicians, to do excellent surgery. After all is said and done, good surgery based on sound medical principles, is responsible, to a larger degree, for the record that has been made by the medical department of the United States Army. As never before in the history of man, the medical department is "conserving the fighting strength."

[1]From civilian practice to military service. Med. Ann. Dist. Columbia, 1942, 2: No. 4.

CERVICAL LYMPH NODE METASTASIS AS THE FIRST SYMPTOM OF CANCER

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THE subject of cervical metastatic cancer is ordinarily considered of significance from the standpoints of treatment and prognosis alone, since the average physician regards metastasis as a secondary or late symptom found only in association with a readily demonstrable primary growth. This view also prevails in the medical literature on cancer of the mouth and pharynx. It is not generally realized that cervical metastasis frequently occurs as the initial, and for a time, the only symptom from an otherwise silent primary malignant tumor in the upper respiratory or alimentary tracts or, rarely, from a primary growth in some viscus below the clavicle. Such silent primary lesions are often not suspected or at least not found when the patients first seek medical advice because of cervical tumors (cervical lymph node metastases). Even after repeated and thorough examinations, the primary growth may not become evident for months or even years, and it is certain that many persons die of widely disseminated cancer undiagnosed as regards the origin of the growth.

Unless the nature of this phenomenon is clearly understood, namely that the symptoms from the primary and secondary lesions are sometimes reversed chronologically, then the diagnosis may be missed, or at least delayed until the malignant growth has become widely disseminated and incurable. In other instances, the metastases in cervical lymph nodes may be considered erroneously as the primary site of origin of the growth and consequently such entirely inadequate diagnoses as "carcinoma of the neck" and "sarcoma of the neck" are made.

The cancer patient or his family naturally are most concerned with the immediate symptoms which in many instances (especially in the later stages) may be the result of metastasis (pulmonary, osseous, lymph nodal, etc.); therefore, in a given case, the layman is likely to think of cancer as affecting the lungs, the bones, or some other structure, and to him it appears to be of little significance and somewhat beside the point that the disease may have originated specifically in some such area as the tonsil, the breast, or the stomach. Strangely enough, many physicians have the same lay point of view.[1] Since all methods of treatment (surgery and radiation) at present are strictly local in their application, it should be plain that cure is not possible unless the location of the primary growth is discovered.

The purpose of the present report is to discuss this phenomenon (cervical lymph node metastasis appearing as the initial symptom of cancer) from the standpoints of incidence, site of the silent primary lesion and clinical course, with special reference to differential diagnosis. The data used in this study were obtained from a review of about 3,800 consecutive cases, all observed at the Memorial Hospital from 1933 to 1937. The character of this clinical material is shown in Table I.

In Table II are listed the cases of 218 patients who at first complained only of cervical tumors which were subsequently proved to be carcinomatous, and therefore probably meta-

From the Head and Neck Service, Memorial Hospital, New York.

[1]One is often struck by the fact that some physicians (usually not greatly interested in cancer) refer to patients as suffering from or as having died of cancer of the lung or of the pelvis, etc., and subsequently add as a relatively unimportant afterthought that the breast or uterus was removed for a growth at some previous time. Similarly, when investigating the cause of death in untraced cancer patients, it is often found that death certificates have been filed bearing such diagnoses as "carcinoma of the lung," of "the pelvis," of "the liver," etc., when as a matter of fact the patients in question when last seen were known to be suffering from widely disseminated cancer originating in some such site as the breast, the tongue, or tonsil. The actual proportion of such erroneous diagnoses in the recording of cancer deaths is undoubtedly large enough to vitiate the generally accepted figures as to the anatomic distribution of primary malignant tumors. As the result, many dubious conclusions are drawn by some public health authorities, biometricians, and medical writers. For example, certain writers in recent years have announced in all seriousness that lung cancer is increasing at an alarming rate. One cannot help but suspect that this increase may be due at least in part to the manner of reporting the cause of death in cases of pulmonary metastases from various primary growths.

TABLE I.—SUMMARY OF THE TOTAL CLINICAL MATERIAL USED IN THE PRESENT STUDY OF INITIALLY SYMPTOMATIC CERVICAL METASTASIS FROM SILENT PRIMARY MALIGNANT TUMORS

Anatomic site of the primary cancer	No.	Per cent	Total number of cases
Mouth and pharynges			1867
Cervical metastasis the first symptom in	145	7.8	
Thyroid			89
Cervical metastasis the first symptom in	7	8	
Salivary glands			141
Cervical metastasis the first symptom in	0		
Various anatomic sites below the level of the clavicle			1744
Cervical metastasis the first symptom in	11	0.6*	
Breast, 3 in 1000, or .03%; stomach, 0 in 200; lung, 0 in 200; esophagus, 2 in 200 or 1%; pancreas, 2 in 74 or 2.7%; kidney and adrenal, 4 in 70 or 5.7%.			
Miscellaneous cases of initially symptomatic cervical carcinomatous masses			55
No primary ever found	47		
Lived 5 years and therefore probably branchiogenic carcinoma.	8		
Total number of cases reviewed..			3896

*Early cervical metastasis associated with slight although definite early symptoms of a primary lesion were found as follows: Lung....13 (6.5%); Stomach....4 (2%); Esophagus....1 (.5%).

TABLE II.—TIME AND METHOD OF DISCOVERY OF THE LOCATION OF INITIALLY SILENT PRIMARY LESIONS IN 218 CASES IN WHICH CERVICAL METASTASIS APPEARED AS THE FIRST SYMPTOM OF CANCER

	No.	Per cent	Total
Determinate cases (primary lesions eventually found in all)			163
Primary lesion discovered by a referring physician* before admission to Memorial Hospital	57	35	
Primary lesion discovered first in the admitting office of the Memorial Hospital	56	34	
Primary lesion not found by referring physician or in the admitting office of the Memorial Hospital and discovered first in the Head and Neck Clinic within 1–2 weeks after admission or 3–4 examinations	34	22	
Primary lesion discovered only after repeated examinations in the Head and Neck Clinic and a delay of 1–54 months	16	9	
Indeterminate cases (biopsy from the cervical mass revealed squamous or epidermoid carcinoma, but no primary was ever found)			55
Total number of cases			218

*The term "referring physician" does not necessarily mean that the patient had been seen by only one doctor before being referred to the Memorial Hospital. In many cases, usually depending upon the accessibility of the primary lesion, the patient had been seen by one, two, three, or even four doctors before being referred to the Memorial Hospital.

static from silent primary lesions. In 163 of these cases, the silent primary lesions were eventually discovered and proved by biopsy, while 55 cases had to be considered as inconclusive since no primary lesions were ever discovered. It should be noted that this clinical material is not uniform in character and significance; for example, at one extreme are found the cases of those patients who sought medical advice complaining only of cervical tumors (enlarged cervical lymph nodes) while disregarding slight symptoms of a primary lesion. Such disregarded symptoms can sometimes be elicited and the primary growth immediately found by the examining physician. At the other extreme are the cases of those patients complaining only of cervical tumors in whom small primary lesions were discovered only after repeated and careful examinations and a delay of from 1 to 2 years.

Definition. The *sine qua non* that lymph nodes are diseased from any cause is an increase in size, and it is only when definite enlargement has taken place that such other characteristics as consistency, tenderness, mobility, or contour can be of much diagnostic significance. In a discussion such as the present one, it would be useful, therefore, if one could specify the normal size of each of the various lymph nodes (or at least of the main nodes) so as to permit a definition of what should be considered abnormal enlargement. Unfortunately, no exact rule can be given in this regard. Consequently, before proceeding further, it is necessary to define what is usually understood by the loose terms "lymphadenopathy" and "enlargement of lymph nodes."

For practical purposes, it may be assumed that when a physician states that lymph nodes are "enlarged," he intends to indicate that they are abnormal, that is to say, diseased, or at least that, being uncertain, he advisedly uses an ambiguous term. Contrary to an apparently widely accepted belief, lymph nodes are not necessarily "enlarged"

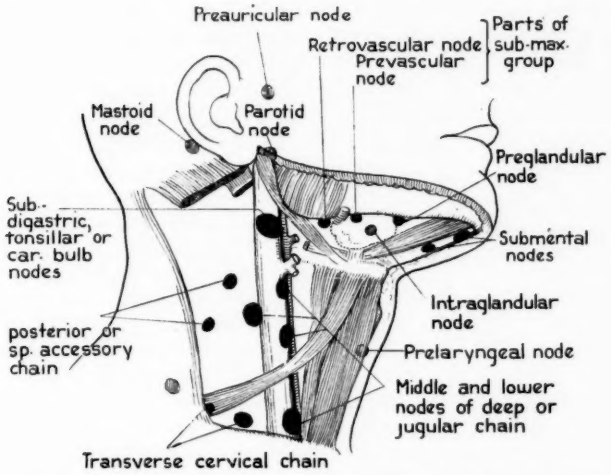

Fig. 1. Diagram of the most frequent positions of cervical lymph node metastases with the most likely sites of the primary lesions causing them.

simply because they are palpable.[1] In the normal cervical lymphatics, the nodes vary in size from less than a millimeter up to 1.5 centimeters or occasionally even 2 centimeters in diameter. The larger normal cervical lymph nodes (1 to 2 cm. in diameter and therefore readily palpable) are found, however, only in certain locations, namely, the upper deep cervical (subdigastric) and the prevascular and retrovascular submaxillary areas (Fig. 1). The occurrence of lymph nodes larger than 1 centimeter in diameter in other regions of the neck can usually be considered abnormal. It is fortunate, however, that for the present discussion, no exact line of differentiation in size between normal and abnormal nodes is necessary since in the cases included in this study, the nodes when involved by metastases were invariably at least 3 centimeters and usually 4 centimeters in diameter at the time when the patients were first admitted.

A distinction should be made also between enlargement of cervical lymph nodes and enlargement (or other abnormality) of the true *cervical glands* (submaxillary salivary, sublingual salivary, parotid salivary, thyroid, etc.). Abnormalities of these true glands have no relation to the subject under discussion except from the viewpoint of differential diagnosis. It will be assumed, furthermore, that cervical lymph node enlargement will not be confused with other cervical tumors, either benign or malignant, such as: branchiogenic and thyroglossal cysts, lipomas, thyroid adenomas, soft part sarcomas, and similar conditions.

INCIDENCE OF CERVICAL METASTASIS AS A FIRST SYMPTOM OF CANCER

A survey of the histories of several hundred cases in our clinic as listed in Table I reveals that the appearance of a cervical swelling or mass (metastasis) was the first and for a time the only symptom noted by the patient in about 8 per cent of all cases of cancer of the mouth, pharynx, and thyroid. In primary

[1] In clinics where large numbers of patients with mouth and pharyngeal cancer are followed, it is clearly recognized that certain lymph nodes of the neck are palpable in the majority of normal persons. For this reason, the palpability alone of lymph nodes, either in normal persons or in those who have cancer should not be considered as necessarily indicating metastasis. Unfortunately, there is a widespread belief that all palpable lymph nodes are abnormal, as for instance, in some texts on physical diagnosis, one finds such misleading phrases as "lymph nodes enlarged to 1 centimeter in diameter" without any further qualification. One must, therefore, conclude that the author erroneously considers any lymph node 1 centimeter in diameter, wherever situated, to be abnormal or possibly being uncertain, he prefers to leave the decision to the reader. Similarly, in some publications on intraoral cancer, the sole fact that lymph nodes are palpable is obviously considered a presumptive sign of metastatic cancer. In such publications, the subject of cervical metastasis is sometimes disposed of by giving the percentage of cases in which the nodes (usually referred to as "glands") are either "palpable" or "not palpable."

TABLE III.—SITE OF THE EVENTUALLY DISCOVERED PRIMARY LESION ABOVE THE LEVEL OF THE CLAVICLE IN 152* CASES IN WHICH THE FIRST SYMPTOM WAS THE PRESSURE OF A CERVICAL TUMOR (LATER PROVED TO BE CARCINOMATOUS)

(1933–1937)

Site in which primary lesion was eventually discovered	Number of cases	Per cent of total
Tonsil	35	23
Nasopharynx	33	22
Tongue	29	19
Extrinsic larynx	22	14
Floor of mouth	10	7
Pharynx	9	6
Thyroid	7	5
Palate	4	3
Paranasal sinuses	1	0.6
Gums	1	0.6
Intrinsic larynx	1	0.6
Total number of cases	152	100

*The discrepancy between the number of cases listed in this table (152) and that listed in Table II (163) is accounted for by the 11 cases with primary lesions below the level of the clavicle as listed in Table I.

growths below the clavicle, metastasis rarely occurred as a first symptom with the exception of the kidney and adrenal (5.7 per cent) and pancreas (2.7 per cent). Probably it is not generally realized that initially symptomatic cervical metastasis occurs so frequently from a silent primary lesion; this is especially true in cases of cancer of the mouth and pharynx for, on the average, 1 in about 12 patients so afflicted first seeks medical advice because of a cervical mass.

Table II gives the time of discovery of the primary lesions above the level of the clavicle in 163 cases in which patients complained only of enlarged cervical nodes. It will be seen that on admission to the clinic at Memorial Hospital, the silent primary lesions had been discovered already by the referring physicians in about one-third of the cases. In another third, the primary lesions were found in the admitting office at the time of the first visit, while in the remaining third, the location of the primary growths was discovered only after a delay of several weeks or months. In addition to the above mentioned, there are listed in Table II 55 cases of patients who complained only of cervical tumors (proved histologically to be either squamous or epidermoid carcinoma) in whom no primary lesions were ever found. In a part of the latter group, the follow-up was inadequate, and it is possible that in some of these, the primary growths became obvious before death. In others, regularly followed after treatment to the cervical tumor, no primary lesions were ever demonstrated up to the time of death or after a follow-up of 5 or more years (Table VI).

Topographic distribution of silent primary lesions in the mouth and pharynx. In Table III are listed the sites at which the silent primary lesions above the level of the clavicle were discovered in 152 cases of patients complaining only of cervical masses. The primary growths, if above the level of the clavicle, are most often found in the tonsil or nasopharynx, followed next in the order of frequency by the tongue, extrinsic larynx, floor of the mouth, palate, and paranasal sinuses. While it is plain to see why a growth in the nasopharynx, tonsil or base of the tongue should remain symptomless for a time, it is curious that growths in such tactually sensitive areas as the floor of the mouth or palate should be frequently overlooked by both the patients and the first examining physicians.

The following data are from previously published studies on several anatomic forms of cancer from the Head and Neck Service of the Memorial Hospital with reference to the percentages in which cervical masses appeared as a first symptom (10, 12, 14, 15, 16): nasopharynx, 50 per cent; tonsil, 33 per cent; base of tongue, 30 per cent; floor of mouth, 10 per cent; gums, 4 per cent.

Cervical metastasis as a first symptom in primary cancer below the level of the clavicle. Cervical lymph node metastasis may occur as part of the wide dissemination in the later stages of cancer from a primary growth in any part of the body. The occurrence of a supraclavicular mass, usually on the left and sometimes referred to as the *signal node* has long been considered of particular significance as suggesting the presence of a silent primary malignant growth below the level of the clavicle.[1]

[1]This concept dates from Troisier (21) who in 1889 reviewed a series of cases in which he found "cervical masses" in the lower neck, usually on the left, in association with malignant tumors of the abdomen, mainly the stomach. Troisier believed these cervical tumors to be lymph node metastases which had developed from tumor emboli by way of the thoracic duct. It is now known that many of these supraclavicular masses on the left are not actually lymph node metastases but rather cancerous masses growing within the thoracic duct or its tributaries in the neck. Willis (24) has discussed the mechanism of this phenomenon in some detail.

From the standpoint of the present study, it is important to distinguish between those rare cervical lymph node enlargements which occur as the first and only symptom and those (more common), though occurring early in the course of the disease are nevertheless preceded by definite though slight or ill-defined symptoms of the primary growth below the level of the clavicle. One must also distinguish those cases of cervical metastatic cancer which occur several years following the removal or treatment of a primary growth below the level of the clavicle. In such cases, the past history of the primary tumor is sometimes not readily elicited, or in any case, the probability of any causal relationship may at first seem remote.[1]

In the course of this study, we reviewed a series of about 1,700 cases of cancer at various primary sites below the level of the clavicle as listed in Table I and found that cervical lymph node metastases rarely occur as the first and only symptom from a primary growth below the level of the clavicle (11 in 1,744 cases, or 0.6 per cent). In this series, nevertheless, it occurred as an early, but not first, symptom in an additional 18 of 1,744 cases (1.0 per cent).

In the 163 cases of initially symptomatic cervical metastases, as discussed in this report, the primary growth was below the clavicle in only 7 cases or 3 per cent.

It seems to us that both the diagnostic and the clinical significance of the so called *signal node* has been somewhat overemphasized. In personal communications, Dr. Frank Adair of the breast service and Dr. George Pack of the gastric service of the Memorial Hospital stated that they considered cervical metastasis of little clinical significance in either breast or gastric cancer since this complication rarely occurred as an early symptom. Dr. Lloyd Craver of the admitting department of the Memorial Hospital also in a personal communication stated that although he considered the signal node of "important diagnostic significance," nevertheless he conceded that "in most of the cases there are associated symptoms indicating the site of the primary lesion." It seems fair, therefore, to conclude that the *signal node* is sometimes an early but rarely an initial symptom.

[1]Several examples of such a complication have been noted at Memorial Hospital, as for example, a case of cancer of the cervix in which treatment was followed by apparent freedom of disease for 10 years when an enlarged neck node appeared which proved to be histologically identical with the uterine tumor. In a second case, an orchidectomy was performed for embryonal carcinoma of the testicle, and the next clinical evidence of the disease was the appearance of a cervical lymph node metastasis 2½ years later. In several cases of melanoma of the skin of the trunk and extremities, the first evidence of late dissemination was the appearance of a cervical mass. Other similar observations have been made at the Memorial Hospital in cases of cancer of the breast, lung, stomach, kidney, and pancreas.

SYMPTOMS AND CLINICAL COURSE OF CANCER APPEARING FIRST IN THE FORM OF CERVICAL METASTASIS

It is a common observation that malignant tumors, either primary or metastatic, if situated so as not to press upon or deeply invade any vital structure may for a time cause no subjective symptoms, such as discomfort or dysfunction. This is particularly true of cervical lymph node metastases, which may reach a diameter of 7 to 8 centimeters or even larger without producing any objective symptoms other than visibility and palpability. It appears difficult, nevertheless, for the average layman and even for some physicians to realize that a disease as malignant as cancer can exist anywhere without causing pain or discomfort. For this reason, malignant cervical tumors unaccompanied by subjective symptoms (pain, tenderness, disability) are commonly first considered to be inflammatory in origin, especially when the enlargement has been rapid.

Discovery of cervical lymph node metastases by the patient. When cervical lymph node metastasis occurs from a silent primary lesion, the patient sometimes states that the swelling (3 to 5 cm. in diameter) appeared suddenly at a specified time and that he is certain it was not present the day before. Cervical tumors of this size histologically proved to be squamous or epidermoid carcinoma must, of course, have been present for several weeks or even months. Such cases demonstrate the frequent unreliability of patients' histories when the symptoms are purely objective. Since there are seldom any subjective symptoms of the cervical swelling, the patient almost always delays seeking medical advice. After the tumor has once been noted, the patient then pays a little closer attention to it and the observation that there has been a *steady increase in size* is the usual reason for his finally seeking a medical consultation. In

TABLE IV.—SYMPTOMATOLOGY IN 218 CASES IN WHICH A CERVICAL TUMOR (LATER PROVED TO BE CARCINOMATOUS) WAS THE FIRST AND FOR A TIME THE ONLY COMPLAINT

	Number of cases	Per cent
Group I	99	45
In Group I, the visible and palpable presence of a cervical tumor was the only complaint. No associated symptom of a primary lesion was elicited by the first examining physician. A primary lesion was eventually found in all these cases.		
Group II	64	29
In group II, the visible and palpable presence of a cervical tumor was the only complaint, but the presence of other slight symptoms was elicited by the examining physician and a primary cancer at another site demonstrated on physical examination.		
Group III	55	26
In group III, the visible and palpable presence of a cervical tumor was the only complaint. No primary cancer elsewhere was ever found.		
Total number of cases	218	100

our series, only about 10 per cent of these patients had consulted a doctor within the first week after noting the cervical mass. The average delay in seeking medical advice was 6 weeks.

Disregarded initial or early symptoms of the primary lesion. The patient seeking medical advice because of a painless cervical mass is not likely to mention voluntarily any apparently (to him) unrelated symptoms. That such pertinent symptoms are actually present and can be elicited on questioning in about 30 per cent of all patients complaining only of cervical tumors is shown in Table IV. Some examples of frequently disregarded symptoms are: slight though persistent deafness or "stuffiness" in one ear, slight soreness of the throat or mild dysphagia, which the patient does not consider of any particular importance, inasmuch as there is no marked distress or disability.

If the investigation is pursued a little further in an attempt to learn why the slight symptoms of primary lesions are so often disregarded, it is sometimes found that the patient is suffering from a number of the infirmities of old age, and to him it seems more reasonable to deal with one thing at a time, that is, the cervical tumor. The failure to discover these disregarded symptoms of the primary lesion when the patient seeks medical advice is ordinarily due to the fact that no inquiry is made by the examining physician.[1]

Eventual discovery of the primary lesion. If the examining physician is well informed as to the symptomatology of cancer, he will make careful inquiry as to any symptoms which might suggest the location of a primary lesion in all cases of cervical tumors. If no clue appears following such questioning, he will proceed with an examination of the mouth, and of the oral and nasal pharynges. The discovery of the primary lesion (if present) is not difficult in most cases. A review of our data suggests that a failure to discover the primary growth is due in most instances to a failure to make any examination whatsoever of the mouth or pharynx, or at least a failure to employ adequate instruments and apparatus (headlight, throat mirror, etc.).

In Table II are listed the cases of initially symptomatic cervical metastasis and the time and place of the discovery of the silent primary growths. It is to be noted that in 163 cases of the present series, the manner of discovery of the silent tumors was about as follows: in one-third of the cases by a referring physician; in an additional one-third of the cases by an admitting physician of the hospital; in the remaining one-third of the cases, the majority of the silent primary growths were discovered only after examination by the attending staff of the head and neck service. It should be noted further that in 55 additional cases primary lesions other than the cervical tumors were never found, either up to the time of death or after at least a 5 year period of observation. It should be stated that the failure by the referring physician to discover the silent primaries in these cases is apparently due more often to failure to look for them rather than to the obscurity of the lesions themselves.

[1]A typical example of a failure to elicit symptoms of a primary lesion is shown in the following case. A male, aged 60, applied to the surgical out-patient department of a large metropolitan hospital complaining of a "lump in the neck." He was immediately operated upon in the out-patient clinic, the mass incised, and a wedge-shaped specimen removed. When the histologic report was returned as "squamous carcinoma," he was referred to the Memorial Hospital with a diagnosis of "carcinoma of the neck." On admission there, a cursory examination of the mouth revealed an ulcerated, granular lesion 2.5 centimeters in diameter in the mucosa of the cheek. On further questioning, the patient admitted that he knew his mouth was sore, but that he thought the cause was bad teeth from which he had been suffering for many years. It is plain that the out-patient surgeon had made no inquiry as to any symptoms regarding the mouth, nor any examination before proceeding with a biopsy of the cervical mass.

The subject of silent primary tumors in the nasopharynx deserves particular attention. As has previously been described from our clinic (12), the most frequent initial symptom in nasopharyngeal cancer is cervical metastasis (in over 50 per cent of all cases). In the series of cases analyzed for this report, the silent primary lesions in the nasopharynx were discovered first by one of the attending staff of the head and neck service in about 65 per cent of all the cases, that is, in 65 per cent of the cases, the primary lesions were missed by both the referring physician and the admitting physician. The reason that so large a proportion of these silent growths were at first missed is that this anatomic site requires special apparatus (headlight, throat mirror, soft palate retractor), and a skill acquired only after considerable experience. Such experience engenders the conviction that if the primary lesion is not found elsewhere, particular attention should be paid to the nasopharynx. In the majority of such cases, the primary lesion appears as a fungating, granular outgrowth (1.5 to 2 cm. in diameter or more) at the junction of the posterior and lateral nasopharyngeal walls (fossa of Rosenmueller).

Anatomically, the nasopharyngeal cavity is wider than the air passages immediately distal and proximal so that tumors in this region do not cause any obstruction to respiration until they reach a size of 5 to 6 centimeters in diameter. Nevertheless, most growths of the nasopharynx can readily be visualized on the first visit by mirror examination through the open mouth with the free edge of the soft palate retracted forward. In this manner, the whole nasopharynx can be visualized, by means of binocular vision. Far too often, the discovery of lesions in the upper respiratory and alimentary tract is missed because the examiner places too much dependence on the strictly limited field of monocular vision, permitted by complicated endoscopic and periscopic instruments (antrascope, nasopharyngoscope, laryngoscope, etc.).

In the extrinsic larynx or pharyngeal walls, the silent primary lesion can usually be demonstrated by mirror examination. In these regions, there is less tendency for the primary growth to remain so small as to be undetected by the naked eye than in the nasopharynx, the base of the tongue, the tonsil, the floor of the mouth, etc. Lesions in the pyriform sinuses or postcricoid region cannot always be demonstrated clearly by mirror examination alone, though in the average case, asymmetry of the walls of the pyriform sinuses or of the postarytenoid region can be detected, suggesting that an endoscopic examination at a little lower level is in order.

The number of cases of silent growths below the clavicle with initially symptomatic cervical metastasis, is too small to permit of any definite conclusions (11), but it is noteworthy that in both of the 2 cases of cancer of the pancreas listed in Table I, the primary lesions were discovered late in the course of the disease and only after repeated examinations.

In Table II are also listed a total of 16 cases in which the primary lesions were not discovered until after repeated examinations and some delay, varying from 1 month to 54 months. Superficially considered, this delay might be disposed of by concluding that obvious primary lesions were repeatedly missed by the examining surgeons in our clinic, but we feel certain that such was not the case. These 16 patients were examined repeatedly by various members of the attending staff of the head and neck service with the specific purpose of locating the suspected primary lesions. In all of these cases, the primary growths, when eventually discovered, were only a few millimeters in diameter. In these patients, silent primary lesions were discovered only after 1 to 54 months and after 4 to 55 examinations conducted by four or five different attending surgeons of the head and neck staff. In such cases, it is the routine practice to make at least 5 or 6 complete examinations of the mouth and pharynx during the first month and at least one examination per month thereafter until a period of at least 5 years is passed or the primary growth is discovered.

These observations prove, at least to our own satisfaction, that a primary lesion may remain so small as to be unrecognizable to the naked eye, that is, it may produce no significant alteration in the surface contour

TABLE V.—CLINICAL COURSE AND END-RESULTS IN 55 CASES OF CARCINOMATOUS CERVICAL TUMORS IN WHICH NO PRIMARY LESION WAS EVER FOUND

	Number of cases	Per cent
Alive and well after 5 years or more and therefore fulfilling the criteria of branchiogenic carcinoma	8	15
Dead of cancer or followed for less than 5 years without the discovery of a primary lesion and therefore diagnosed as "Cervical Metastatic Cancer—No Primary Found"	47	85
Total number of cases	55	100

of the mucosa nor any noticeable ulceration, but may nevertheless metastasize so as to produce bulky cervical tumors, sometimes 4 to 5 centimeters in diameter. Such phenomena lead to interesting speculations as to the nature of the factors which determine the rate of growth in malignant tumors. For instance, why do certain primary malignant tumors behave so much like normal tissues in that they respond to growth control influences and remain microscopic in size yet nevertheless possess an uninhibited capacity to metastasize? Furthermore, once having metastasized, why do the same growth control factors likewise not inhibit the rapid and bulky growth of the metastases? In these cases, one must assume that there are differences in the biologic conditions at the primary and secondary sites of growth and that in these cases, at least, the growth control function is not necessarily systemic, but local and possibly neurotropic.

In Table V, it will be seen that in our series, 47 patients with histologically proved carcinomatous cervical tumors died of their disease or were lost track of without the discovery of any primary lesions. The question naturally arises as to whether these cases all represent branchiogenic cancer or primary lymph node cancer or whether primary growths of the mucous membrane existed but remained small and silent up to the time of death or appeared after the patients were lost to follow-up.

After a consideration of all known facts, we have decided upon the following practical method for the classification of cases of cervical epithelial cancer in which no primary lesion is ever discovered. (1) If the patient has survived 5 years or more following treatment of a squamous or epidermoid cervical carcinoma of the soft parts of the neck without the discovery of a primary lesion, the probable though not absolutely proved diagnosis is "branchiogenic carcinoma." (2) If the histologic examination of such cervical tumors revealed transitional cell carcinoma or lymphoepithelioma, and the patient remains well for 5 years following treatment, the diagnosis of "branchiogenic carcinoma" is less tenable, and it is probable that an undetected primary lesion did exist somewhere in the pharynx, but was sterilized in the field of radiation to the cervical mass. (3) If the patient with any form of carcinomatous cervical tumor has died of the growth or was lost track of before 5 years without the discovery of a primary lesion, then the diagnosis must remain indeterminate, since it is possible that a primary lesion did exist and remained silent or at least undiscovered up to the time of death.

In the case of a carcinomatous cervical tumor, we consider as inconclusive any single negative examination for a primary lesion in the mouth and pharynx no matter how competent the examiner. The survival of the patient for at least 5 years is the only tenable proof that there is no primary growth elsewhere. One of the least tenable arguments advanced by those who favor the theory of the frequent occurrence of primary cervical cancer is that no primary was found on a single examination by "a nose and throat specialist." If the examiner had been competent, he would have realized that his single examination was inconclusive. Pathologists are particularly prone to fall into the error of drawing conclusions in such cases from the fact that they find no primary lesions in the mouth or pharynx at autopsy. Any clinician who has repeatedly searched for and finally located and proved by biopsy the smaller silent and more elusive primary lesions will have little confidence in the pathologist's ability to find such growths in the mouth or pharynx after death.

It is our considered opinion that many patients die of widely disseminated cancer

with the site of the primary growth undiscovered. During the past several years, in preparation for this study, we have been particularly interested in obtaining postmortem examinations in patients dead of widely disseminated cancer with undiscovered primary growths. In none of these postmortem examinations was a primary lesion found in the mouth or pharynx which had not been demonstrated previously by clinical examination prior to death. In several instances, however, silent primary growths have been disclosed at autopsy in such sites as the lung, pancreas, stomach, adrenals, kidney, and intestine. Much of the theory as to the occurrence of primary carcinoma or endothelioma of cervical lymph nodes is based upon invalid conclusions drawn from false observations. A further discussion of this subject will be treated under a subsequent heading.

DIAGNOSIS

A clinical diagnosis of cervical metastatic cancer (or any cervical tumor) depends almost always upon the discovery either by the patient or by the physician of its palpability or of a visible swelling or enlargement. Discomfort and dysfunction from superficial cervical tumors seldom occur except as late symptoms. Early diagnosis depends, therefore, upon the alertness of the patient and the physician, and a delay in diagnosis can be due only to a failure of one or the other to recognize a moderate departure from the normal.[1] Only occasionally is an alarmist physician or an apprehensive patient likely to err in diagnosing cancer in cases of benign enlargements such as hyperplastic lymph nodes or slightly swollen salivary glands.

As has been mentioned previously, palpability of lymph nodes by itself is no proof of abnormality. Lymph nodes, 2 centimeters in diameter, in the subdigastric area (carotid bifurcation) may exist bilaterally for years in perfectly healthy persons. Just when a lymph node larger than the average should be considered diseased must rest mainly upon clinical judgment. Bilateral, symmetrical, moderate, soft enlargement is of little import. Unilateral or asymmetrical enlargement, even though of only moderate degree, is of much more clinical significance. Other characteristics suggesting the possibility of metastasis are: firm consistency, absence of pain, tenderness, or any other sign of inflammation, and lastly, chronicity and a tendency toward progressive enlargement. The experienced clinician can make a high percentage of correct diagnoses in cases of lymph node metastasis from these clinical features alone although histologic confirmation is essential in all cases.

It should also be recognized that several structures in the neck are normally palpable and can lead the inexperienced clinician to a diagnosis of an abnormal mass or tumor. The submaxillary salivary gland, palpable in all persons, is perhaps responsible for more errors in the diagnosis of cervical metastasis than any other structure. When this confusion occurs, the physician almost always speaks of palpable "cervical glands," indicating a belief that metastasis can take place to any of the glandular structures of the neck, indiscriminately grouping together the salivary glands and the lymph nodes. It is significant that many surgeons having this mistaken concept are under the impression that metastasis occurs only to the cervical "glands" (never to any other tissue), and that removal of all these "glandular" structures will prevent spread of the tumor, since the metastases will then have no place to lodge and grow. Such illogical ideas are responsible for many of the prophylactic neck dissections carried out at the present time. The parotid salivary gland is less frequently palpable than the submaxillary salivary gland, and even when slightly enlarged, it seldom leads to an erroneous diagnosis of metastases except by those physicians who feel that metastasis occurs indiscriminately to all "glands."[2]

[1] A patient whose only complaint was a cervical tumor (4 cm. in diameter) was recently observed at the Memorial Hospital with a silent primary cancer in the floor of the mouth. He stated that he had first become aware of the cervical swelling by observing it in a mirror on a Fifth Avenue bus.

[2] In the medical literature, lymph nodes are frequently also referred to as "lymph glands." Medical dictionaries and anatomical texts use both terms. Such terminology obviously derives from the time when the function of lymph nodes was not as clearly differentiated from that of the true glands (parotid salivary, submaxillary salivary, lingual salivary, and thyroid). The fault in referring to lymph nodes as lymph glands is not so much that it is incorrect as that it is confusing and therefore inadvisable. For instance, in the literature on intraoral cancer, when the subject of cervical lymph node metastases is under discussion, cervical "glands" are often spoken of as being "palpable," "enlarged," "soft," "hard," and even as being "present" or "absent." The helplessly confused reader is then left to interpret what clinical significance he can attach to such vague observations in terminology. (*Continued next page.*)

There are several bony structures in the neck of some importance in this connection because of the likelihood of confusion with and the need of differentiation from enlarged, indurated lymph nodes. The greater cornu of the hyoid bone lies just anterior to the bifurcation of the carotid artery and may readily confuse the inexperienced. Pressure on the opposite greater cornu readily demonstrates that the supposed mass is actually part of the mobile hyoid bone. The transverse process of the sixth cervical vertebra (carotid tubercle) may be mistaken for a metastasis in the midportion of the internal jugular chain of lymph nodes.

When there is even a moderate degree of arteriosclerosis in thin persons, the carotid bulb may be unusually prominent. Since the main subdigastric node lies almost directly over this structure, it is sometimes difficult to distinguish an enlarged lymph node transmitting arterial pulsations from the carotid bulb itself. In any of the above situations, if a decision cannot be reached on the basis of clinical examination alone, aspiration biopsy may solve the problem. If the report is positive, the diagnosis is certain, but a negative diagnosis is of no value.

The probable benign or malignant nature of cervical tumors as judged solely by the clinical history. As we have already stated, cervical tumors, whether malignant or benign, seldom produce subjective symptoms until far advanced. For this reason, the absence of discomfort or dysfunction is of little significance in differential diagnosis.

The stated duration, if long, of a cervical tumor can be of considerable importance. If, for instance, the patient states that the mass has been present for several years, the probability is that its character is benign or at least relatively so. It must be realized, however, that thyroid cancer may develop in a previously benign adenoma of several years' duration and that the same is true of cancer developing in benign mixed tumors of the parotid and submaxillary salivary glands. Furthermore, some soft part sarcomas are of relatively slow growth. On the other hand, metastatic carcinoma in lymph nodes grows rather rapidly, that is, its duration up to the time of producing palpable tumors or even of producing disabling symptoms is usually a matter of months rather than years.

One of the most serious errors results from giving much credence to the patient's statement that a given mass 3 to 5 centimeters in diameter appeared suddenly, as for instance, overnight. On the basis of such a clinical history, some physicians are misled into believing that a given cervical tumor must therefore be benign, that is, the result of inflammatory hyperplasia of a lymph node. It should be plain that such rapid lymph node enlargement from inflammation must of necessity have been preceded and accompanied by symptoms of acute sepsis in the mouth or pharynx. It is a common experience in cancer clinics that patients with histologically proved cervical metastases from demonstrable primary lesions will state that the cervical tumor, 3 to 5 centimeters in diameter, developed within a few hours. As a matter of general observational knowledge, it must take several weeks or even months for a metastatic tumor to reach such a size.

In brief, when a patient states definitely that a given tumor has been present for several years, the clinical history may be of real significance from the standpoint of diagnosis. On the other hand, a statement of the short duration (a few days) of a given tumor should be given no credence whatever in proceeding with measures for physical diagnosis, such as search for a primary growth, biopsy, and similar steps.

Presumptive cancerous nature of enlarged cervical lymph nodes in the adult. One of us (H. M.) has published repeatedly the statement that chronic asymmetric enlargement of one or more cervical lymph nodes in the adult is cancerous in most instances and probably metastatic from a primary lesion in the oral cavity, the oral or nasal pharynx. This

Close reading and personal communications with surgeons who speak of cervical lymph node metastases as "glands" forces one to the conclusion that many of those who use such terminology believe that cervical metastases from cancer take place indiscriminately to the various "cervical glands," that is, not only to the lymph nodes but to the parotid salivary, submaxillary salivary, sublingual salivary and thyroid glands, and that all of these "glands" are of equal significance from the standpoint of cervical metastases. This error in terminology is often a cause of anxiety to the inexperienced who discover the presence of palpable but otherwise normal submaxillary salivary, parotid salivary, and thyroid glands, which they interpret as being involved by cancer. If the term "node" or "lymph node" were used instead of "gland" or "lymph gland," much of this confusion would be eliminated.

statement may be received with some skepticism by the average reader.[1] On the other hand, if the normal variation of palpability of lymph nodes is recognized and eliminated from consideration in this connection, and if the normal palpability of the three true cervical glands (submaxillary salivary, parotid salivary, and thyroid) also is recognized, then this statement undoubtedly holds true and is of great value from the standpoint of diagnosis.

The clinical picture in cases of initially symptomatic cervical metastasis is typical. There is slow, gradual, progressive asymmetric enlargement of one or more nodes without any local subjective symptoms. Such nodes should always be considered cancerous until proved otherwise. No possible harm can result from an inspection of the oral cavity and pharynx for a primary lesion. If necessary, this can be followed by an aspiration biopsy of the cervical tumor. The most frequent and tragic errors in diagnosis occur when the physician considers first such remote possibilities as tuberculosis, syphilis, or inflammatory hyperplasia, and persists in these beliefs for periods of several weeks or months until the malignant growth extends locally and systemically to become incurable.

When confronted with a diagnostic problem (medical or otherwise), in which there is the possibility of danger or risk, certainly common sense requires that the dangerous possibilities be investigated first and immediately. When these have been ruled out, then one may safely proceed at leisure in solving the problem with the consideration of the benign possibilities. It is a curious commentary on the medical mind that in the diagnosis of cancer, so many physicians should consider first, and spend so much time with, the various benign possibilities that when the malignant progress of the disease eventually forces a diagnosis, it is often too late for cure.

The method of procedure in the differential diagnosis of cervical tumors which might be cancerous should be orderly and systematic. One should begin first with a careful history to elicit any slight symptoms of a primary lesion. The next step is a thorough examination of the mouth and pharynx for a silent primary growth. Readily demonstrable silent primary lesions of the mouth or pharynx can be found and proved by biopsy on the first thorough examination in almost 90 per cent of these cases (Table II). When there is uncertainty, a biopsy specimen should be removed from any suspicious area, especially if there is an abnormal irregularity in contour or a granular appearance of the surface mucosa. If the biopsy report from such mouth or pharyngeal lesions is positive for cancer, the cervical tumor is undoubtedly metastatic and no further proof is necessary to begin treatment.

If, however, no primary lesion is discovered on the first examination, then an aspiration biopsy of the cervical mass should be made at once, and at least a portion of the aspirated material smeared on a glass slide for immediate staining and examination. A report on such a smear can be obtained within 15 minutes, and in most cases, one can state whether or not the aspirated material is cancerous and also whether it is of epithelial or of connective tissue origin. In any event, such a report will serve as a guide to the further search for a primary lesion. Incisional biopsy for the removal of a portion or of the whole of a cervical tumor should never be made until other methods (search for the primary and aspiration for biopsy) have been unsuccessful. The selection and technique of the various biopsy procedures will be discussed at greater length under a subsequent heading.

One of the most reprehensible surgical practices is the immediate incision or excision of a cervical mass for diagnosis without any preliminary investigation for a possible primary growth. There can be no better example of ill-advised and needless surgery. Many surgeons apparently feel that their full responsibilities have been discharged if without

[1]The prevalence of the fallacy that single asymmetric, nontender, enlarged cervical lymph nodes are usually of a benign (chronic inflammatory) nature is typified by the following incident. In a personal discussion of this question, one of New York's leading internists (incidentally on the faculty of a medical school) objected to our emphasis on the probably cancerous nature of most asymmetrically enlarged cervical lymph nodes in the adult. He stated that almost daily, in the wards of a metropolitan hospital, he saw patients with enlarged cervical lymph nodes which he was certain were rarely cancerous. He stated that their etiology could most always be traced to an inflammatory focus, such as dental or tonsillar sepsis or occasionally to syphilis or tuberculosis. He was not entirely clear, however, just what he meant by enlarged lymph nodes (which he referred to as "glands"), and he further conceded that he practically never had the opportunity of following the subsequent clinical course in these patients. It seems plain to us that such confidence in snap clinical diagnosis is not well founded and that under such circumstances, the diagnosis of cancer is frequently missed.

further ado a part (or a questionable "whole") of a cervical mass is handed to the pathologist and a report of cancer returned. It cannot be too strongly emphasized that even though an excised cervical mass is proved histologically to be cancer, nevertheless, the diagnosis is still incomplete until the possibility of a primary growth has been ruled out. About the same information as to the histologic character usually could have been obtained, with much less effort, expense, and loss of time, by a biopsy from the surface of the primary growth or by an aspiration biopsy from the cervical tumor.

In certain cases, although the cervical mass is proved to be carcinomatous, and from its histologic appearance probably metastatic, nevertheless, no primary growth can be found after repeated search. In these cases, the cervical tumor should be treated and the patient re-examined for a silent primary lesion at regular intervals, at least once a month for the first year, and then every 2 to 3 months for a period of at least 5 years before the end-result is considered conclusive.

If at the end of a 5 year period no primary lesion has been found in the mouth and pharynx, the patient is still free of disease, and the histologic report is squamous or epidermoid carcinoma, then a diagnosis of "branchiogenic carcinoma" may fairly be made. Until the 5 year period has elapsed, the tentative diagnosis should be "carcinoma, metastatic to the cervical lymph nodes—primary undiscovered."

Proof of the cancerous nature of enlarged cervical lymph nodes. On most of the clinical services at the Memorial Hospital, it is a routine practice to make biopsies whenever possible before resorting to any major surgical procedure. Preliminary biopsy from ulcerated surface tumors is never omitted. Endoscopy and aspiration biopsy are employed in an effort to prove the histologic character of deep seated tumors. When the treatment is to be by radiation, histologic confirmation is considered essential, otherwise the cases in question can have little or no value for statistical purposes. In all cases of cancer, it is a prudent policy not to subject a patient either to a major operation or to heavy irradiation without histologic proof. If all available diagnostic facilities are utilized, it will rarely be necessary to do so.

In general, these same principles hold true for cervical tumors or cervical metastases. If a primary lesion is found and proved histologically, it is not necessary, from the practical standpoint, similarly to prove the character of the cervical metastasis before proceeding with surgical treatment, since the pathologic character of the excised nodes will be available for record. The latter, however, is not true of treatment by irradiation, in which case aspiration biopsy should be used to prove that the lymph node enlargement is actually of metastatic character. No matter how experienced the examiner, his clinical opinion as to the character of cervical tumors is subject to considerable error.[1] In questionable cases, e.g., small nodes involved by early metastases, histologic proof should be obtained before indiscriminately embarking on a radical operation. Expediency is no justification for the performance of prophylactic neck dissections in the absence of clinical evidences of lymph node involvement.

Repeated examinations of the oral cavity and pharynx for silent primary malignant growths. A single examination of the mouth and pharynx does not rule out the possibility of a silent primary cancer in these regions, despite the experience and competence of the examiner. There are several areas, such as the base of the tongue, tonsil, or fossa of Rosenmueller which characteristically exhibit surface irregularity in the normal subject. For this reason, a primary lesion if present may not be apparent on the first examination. In these sites, repeated inspection often reveals at some given point a slight difference in surface texture, in contour, or in consistency to palpation. One should view with suspicion a tonsil slightly larger than its fellow or a small area of granular tissue protruding at the

[1]In a review of the neck dissections performed in the Head and Neck Clinic in the last several years, it is significant to note that in most cases, an aspiration biopsy of a clinically positive node was made prior to proposing this major operation to the patient. Such a precaution may at first thought seem superfluous, but supported by such evidence, the confidence which the surgeon feels in the necessity for operation is transmitted to the patient who will more readily accept advice and submit to the operation without delay. It is rarely the case that the patient refuses or defers an operation when advised by a surgeon who is confident that metastatic cancer is present and that treatment should be immediate.

orifice of a tonsillar crypt, especially if on the same side as the enlarged cervical node. The irregularity of the surface of the base of the tongue is dependent upon the distribution and amount of lymphoid tissue in Waldeyer's ring. Small silent cancers may sometimes be found at the base of the tongue associated with lymphoid hypertrophy. Biopsy of suspicious areas at these sites will frequently reveal a silent primary growth.

Probable site of the silent primary cancer on the basis of chance alone. Given a cervical metastasis and adjudged solely on the basis of chance, the most likely locations of a silent primary lesion are, in the order of their frequency: tonsil, nasopharynx, pharyngeal wall, extrinsic larynx, tongue, floor of the mouth and palate (Table III). The order of probability of a silent primary lesion being in any one of the several anatomic sites listed is directly proportional to their individual possession of one or more of the following characteristics: (1) function not affected by the presence of small or moderate sized growths; (2) a meager sensory nerve supply; (3) a relatively high proportion of primary cancer occurring at the given anatomic site; (4) the relative and absolute frequency of metastasis from growths at the given site; (5) the relative inaccessibility of the given anatomic site to physical examination.

Position of the lymph node metastasis as an indication of the location of the silent primary growth. It is probably not generally realized that the anatomy of the cervical lymphatics has been recorded in minute detail by anatomists, and that in many respects these lymphatics have constant and uniform features. In brief, certain main lymph channels are always present at the same location; e.g., the internal jugular chain, the spinal accessory chain, the submaxillary and submental node groups, etc. These lymph channels with named lymph nodes and lymph node groups always receive the main lymph drainage from relatively specific anatomic areas although there is some overlapping and no distinct line of demarcation. Nevertheless, this relationship between node groups and a tributary anatomic area is constant enough to permit of certain deductions, and it is possible for an examiner logically to suspect a primary lesion located in a given tributary area when a lymph node metastasis appears at a respective place in the neck. In Figure 2 are shown various lymph node groups with the most likely sites of the primary lesions which may cause the metastases.

The occurrence of lymph node metastases under the upper end of the sternomastoid muscle is of particular value as suggesting a primary lesion in the nasopharynx, even though physical examination fails to reveal any abnormality in the latter region, since the spinal accessory chain receives lymph drainage practically only from the nasopharynx. The same is true of the preauricular parotid node which receives drainage principally from the temple, scalp, eyelids, and orbit. It should be realized, however, that exceptions occur with sufficient frequency so that no portion of the mouth or pharynx should be omitted from careful examination.

Aspiration and incisional biopsy. If a silent primary lesion is not discovered on first examination, it is probably best to make an aspiration biopsy of the suspected cervical metastasis before the patient leaves. The technique of this procedure has already been published (13) and will not be described here. The reason for making an aspiration biopsy rather than waiting for a further examination of the mouth and pharynx is that by this means, it is possible to prove the malignant character of the cervical tumor and with this knowledge, both the surgeon and the relatives or even the patient himself may realize fully the necessity for prompt additional diagnostic or therapeutic measures. While aspiration biopsy seldom permits grading of the tumor, in competent hands it will almost always permit a diagnosis between a malignant and a benign process. An additional advantage is that the puncture of the lymph node metastasis or cancerous mass does not change the clinical setting. It does not require hospitalization or more than a minor operative procedure.

Incisional biopsy should be reserved for those cases in which aspiration biopsy has failed to disclose any positive information.[1]

[1]Even though there are clear histories of previous treatment (either radiological or surgical) of a primary lesion in the mouth or pharynx, surgeons occasionally refer patients to a cancer clinic after they have

When aspiration biopsy of cervical tumors is made by an experienced surgeon, incisional biopsy is seldom required. In the case of lymphomas (lymphosarcoma, Hodgkin's disease, etc.) and certain connective tissue tumors, the pathologist may not be sufficiently certain of his histologic diagnosis on aspiration biopsy to permit the surgeon to proceed with the proper therapeutic measures, and in these the surgeon must often resort to incisional biopsy.

Histopathology of cervical metastasis as an indication of the location of a silent primary growth. An experienced pathologist can almost always diagnose the general character of a malignant tumor from a smear of an aspiration biopsy specimen; for instance, he can often designate such varieties as anaplastic carcinoma, lymphoepithelioma and adenocarcinoma. He can usually make almost as detailed a diagnosis from a paraffin section of an aspiration biopsy specimen as from a larger paraffin section of an excised specimen.

If the pathologist reports anaplastic carcinoma, transitional cell carcinoma or lymphoepithelioma, the clinician may accordingly suspect the primary lesion to be in Waldeyer's ring (base of the tongue, tonsil, or nasopharynx). If, on the other hand, the report is epidermoid or squamous carcinoma, the primary lesion may be somewhere in the mouth or pharynx but more often outside Waldeyer's ring. The report of adenocarcinoma suggests the probability of a primary tumor in one of the major salivary glands, the thyroid, or in an infraclavicular viscus.

In several instances, we have received a pathology report of melanoma on aspiration biopsy of cervical metastases and on further inquiry have found that a barber had burned off a mole of the scalp with acid, or that a doctor had removed a mole with an electric needle some years previously.

carried out an incisional biopsy of a cervical mass. Strangely enough, the referring surgeon usually feels that he has been of real assistance to the cancer clinic in establishing the character of such a cervical mass. As a matter of fact, the succession of clinical events in these cases is usually so typical of metastases from mouth or pharynx cancer that one cannot help but wonder that the surgeon should feel that his surgical procedure was either useful or necessary and why he feels that anyone who is capable of treating cervical metastatic cancer is not also capable of making the diagnosis. Before incising or excising a tumor for diagnosis the surgeon should ask himself what he will do if the histologic report is cancer. If he feels competent to treat the patient for cancer—well and good; but on the other hand, if he proposes to refer the patient with cancer elsewhere for treatment, then he should in all fairness to the patient refer him for diagnosis without preliminary incisional biopsy.

Primary cancer in cervical lymph nodes. One of the most common diagnostic errors in cases of metastasis to cervical lymph nodes from silent primary lesions is the belief that the growth has originated in the nodes themselves rather than as a metastatic spread from a primary site elsewhere. The forms of cancer which are commonly believed to occur primarily in cervical lymph nodes are, in order of frequency: (1) lymphosarcoma, (2) Hodgkin's disease, (3) leucemia, (4) primary carcinoma, (5) endothelioma.

1. *Lymphosarcoma.* It is a widely accepted belief that lymphosarcoma is always of multicentric origin and that the disease usually appears simultaneously in several, often widely separated, groups of lymph nodes. On the basis of such theories, the treatment of lymphosarcoma (by radiation) has often been deliberately only palliative in character. Heavy radiation with the purpose of completely sterilizing the growth in any given site or surgical excision have been considered theoretically unsound and useless. When the outlook is so pessimistic, it is obvious that cure can rarely be obtained since it is not even attempted.

The experience in the head and neck clinic at Memorial Hospital has produced strong evidence that lymphosarcoma above the level of the clavicle usually occurs as a result of a single discrete primary lesion in some portion of Waldeyer's ring (nasopharynx, palate, tonsil, base of tongue), remains localized at first, and then later metastasizes to the cervical lymph nodes exactly as do the more anaplastic epithelial tumors (transitional cell carcinoma and lymphoepithelioma). In the head and neck clinic, it is the practice in every case in which lymphosarcoma is found in the cervical lymph nodes to make an extended and repeated search of the mouth and pharynx, exactly as in epithelial tumors. In the majority of cases, a primary lesion is found somewhere in Waldeyer's ring. Treatment is then carried out exactly as in epithelial tumors, and the cure rates in the respective anatomic sites are about the same as in epithelial tumors. From the standpoint of the present discussion, it is important, therefore, to emphasize that a

diagnosis of lymphosarcoma of cervical lymph nodes should not discourage the search for, and the treatment of, a primary lesion in the mouth or pharynx.

2. Hodgkin's disease. A diagnosis of Hodgkin's disease should not be made until an orderly sequence of diagnostic procedures has been carried out. It should be remembered that the chances in an adult of an enlarged cervical node being involved by metastatic cancer are far greater (about 9 to 1) than of being a primary lymphoma (lymphosarcoma, Hodgkin's disease or leucemia). Hence, the first procedure should be a thorough search for a primary growth in the mouth or pharynx on the assumption that, based on chance alone, such a primary lesion exists. If this search reveals nothing definite, an aspiration biopsy should next be made. If this fails to show metastatic cancer, then only should one resort to incisional biopsy. For differentiation between specific lymphoma groups, aspiration biopsy often is not satisfactory. In general, Hodgkin's lymph nodes are firm and scattered in the neck. According to Slaughter and Craver in an analysis of 265 cases, the apparent origin of the disease is most often (65 per cent) in the neck.

3. Leucemia. Among the malignant lymphomas, there should also be included those cases of leucemia in which the original picture is that of cervical tumors often resembling lymphosarcoma histologically. In the early leucemic phases, only a slightly abnormal blood picture may be found and differentiation is difficult. However, a white blood count should always be made in conjunction with the biopsy of the lymph node, before a conclusive diagnosis of lymphosarcoma is made.

4. Primary carcinoma of cervical lymph nodes. Several theories have been advanced to explain the occurrence of cervical carcinomatous masses without demonstrable primary lesions in the mouth or pharynx. One of these theories is that such growths arise in lymph nodes from epithelial rests. Ewing, in a personal communication, stated to us that he has observed in cervical lymph nodes remnants of glandular acini which he interpreted as embryonal rests, but he conceded that he has never seen any remnant of squamous epithelium in lymph nodes which could possibly be of branchial cleft origin. Stewart, also in a personal communication to us, stated that he has never observed any cellular elements in normal cervical lymph nodes which he could interpret as being of epithelial origin. He suggests that since lymph nodes are normally present within the parotid and submaxillary salivary glands, histologic preparations might show glandular tissue adhering to, or, as artefacts, apparently within, such lymph nodes.

Another possible explanation for the few and isolated reports of epithelial rests in lymph nodes is the marked lymphoid hyperplasia that sometimes occurs in the walls of branchial cysts, occasionally producing almost solid tumors. The latter might be interpreted as being partly caseous lymph nodes and fragments of the cyst wall as epithelial rests. In any case, it seems to us that the evidence is rather tenuous for the existence of epithelial rests within lymph nodes giving rise to cancer. We do not believe that such a hypothesis is necessary to explain the etiology of cervical tumors.

5. Endothelioma of lymph nodes. The term "endothelioma" is applied by pathologists to those tumors which develop from the cells lining blood vessels, lymphatics, or serous cavities. In the present discussion, we are concerned only with the question of endothelioma arising primarily in lymph nodes. According to Ewing, the lymph nodes were included among the probable sites of origin of endothelioma by Zahn in 1874 under the term *sarcoma alveolare epitheliodes.* In 1914, Ewing divided primary malignant tumors arising from lymph nodes into two groups; first, the reticular form or reticular cell sarcoma, and second, the endothelial form or endothelioma, which he believed to arise from cells lining the lymph vessels and sinuses.

Following Ewing's publication in 1914, and up to the present writing, endothelioma of lymph nodes has been described by many pathologists as producing solid tumors of infiltrating character, eventually involving more than one lymph node and sometimes becoming systemic. They caution, however, that

the diagnosis can be confused with tuberculosis and metastatic carcinoma.

During the preparation of this paper, the subject was discussed at some length with both Dr. James Ewing and Dr. Fred Stewart of the pathology department of Memorial Hospital. Dr. Ewing stated that although he had formerly believed in the existence of primary endothelioma of lymph nodes, nevertheless, he had not made that diagnosis in a single instance during the last 15 years. He also stated that since the recognition of such specific histologic groups as transitional cell carcinoma and lymphoepithelioma, he believed most of the cases which formerly were considered endothelioma could now be explained on these grounds. At the present time, he doubts the existence of primary endothelioma of lymph nodes, but is unwilling to exclude definitely the possibility of such tumors. Dr. Stewart stated that in an experience of over 20 years, he has never made a diagnosis of endothelioma of lymph nodes and that he doubts the existence of such tumors. From the clinical standpoint, we can state that the records for the past 20 years in the head and neck service of the Memorial Hospital contain no instance of endothelioma of cervical lymph nodes. We believe it to be significant that although about two hundred new patients, complaining only of cervical lymph node enlargement, apply yearly to the Memorial Hospital, we are, nevertheless, able to make adequate histologic diagnoses in all of these cases without resorting to the term *endothelioma*.

Thyroid and aberrant thyroid cancer. The posterolateral extremities of the thyroid lobes lie close to the internal jugular veins and internal jugular chains of lymphatics. For this reason, primary tumors of the thyroid (either adenoma or carcinoma) may resemble clinically enlarged lymph nodes and may offer some difficulty in diagnosis. The most reliable sign in the diagnosis of thyroid tumors is their motility when the patient swallows. If a mass in the lower or midportion of the neck moves upward with the larynx and trachea on swallowing, it is undoubtedly incorporated in the thyroid gland and is probably either adenoma or carcinoma of the thyroid. Rarely do metastatic deposits from distant primaries lodge in the thyroid itself. Aspiration biopsy with paraffin section of a plug of tissue will usually permit a working histologic diagnosis.

A question too involved to be discussed in great detail in this article is that of cervical metastasis from thyroid cancer, as differentiated from primary cancer arising in aberrant thyroid tissue (1, 3, 8). In this situation, about all that can be determined from any biopsy is that the mass contains thyroid tissue which is malignant. In only a few favorable instances can one definitely state on histologic grounds alone whether the tumor is of aberrant thyroid origin or metastatic. For practical purposes, we feel that regardless of its possible site of origin, once a mass is proved to be cancerous thyroid tissue, a radical neck dissection should be carried out and the corresponding lobe of the thyroid gland should be exposed and carefully palpated for the presence of a small primary tumor. In such cases, even though no primary tumor can be palpated in the thyroid, it is more prudent to resect the corresponding lobe of the thyroid and subject it to more careful histologic examination.[1] We have found microscopic evidence of cancer in the thyroid on several instances in which we could not demonstrate it grossly at operation.

[1]It has not been definitely settled whether aberrant thyroid tissue can occur in the neck and give rise to aberrant thyroid cancer, or whether such masses outside the thyroid are actually metastatic from small primary growths (adenocarcinoma and papillary cancer) in the thyroid. There is considerable evidence on both sides of the question. It is generally admitted that in about one-third to one-half of the cases at first considered tumors of aberrant thyroid, a growth of similar histologic character could be found in the corresponding lobe of the thyroid if a careful search were made (Crile, 3; Cattell, 1). In some of these cases, the primary tumor was not demonstrated macroscopically, but was found only after microscopic examination.

It is known that the primary growth may be small and that all foci may remain stationary for long periods. The authors mentioned appear to believe, however, that aberrant thyroid tissue does exist in the neck and can give rise to aberrant thyroid tumors. The other side of the question is clearly stated. Pemberton (8), of the Mayo Clinic, points out that the position of the so called aberrant thyroid tumors is nearly always identical with that of the deep lymphatics which drain the thyroid gland. Sixty per cent of the cases first thought to be lateral aberrant thyroid were found associated with tumors of similar structure in the corresponding lobe of the thyroid. Dr. Stewart of Memorial Hospital stated in a personal communication to us that save in exceptional instances, he believed it impossible to differentiate histologically aberrant thyroid tissue and lymph node metastasis from thyroid tumors. As Crile has stated, "lymphoid tissues tend to be present in all lateral cervical sinuses, cysts, and embryological anomalies of the neck." Crile advanced the theory of aberrant thyroid masses and stated that they are no exception to the rule as they also contain lymphoid tissue. In Memorial Hospital some primary lesions undetected preoperatively by clinical examination can be found by careful palpation of the corresponding thyroid lobe after surgical exposure in the high average of cases which on more superficial consideration might have been classified as being aberrant thyroid carcinoma. The final answer to the question as to whether lateral aberrant thyroid tumors actually exist or whether they are always metastatic remains unsettled. We believe that there is such an entity as aberrant thyroid cancer, but that like "branchiogenic carcinoma," the diagnosis is too frequently and loosely made.

In the preparation of this report, a total of about 150 cases of malignant tumors of the thyroid were reviewed. In 14 cases (about 9 per cent), the clinical diagnosis on admission was that of cervical metastatic cancer, and a diagnosis of primary tumor in the thyroid was made only at operation. In some of these cases, a fairly large primary thyroid tumor was found at operation in close proximity to an even larger lymph node metastasis; in others, a small primary tumor of the thyroid was found either at the time of operation or on later histologic examination. It is somewhat difficult to evaluate exactly these clinical data since often it is impossible at operation to differentiate anatomically between a lymph node metastasis in the internal jugular chain and a primary tumor in a posterior extremity of the thyroid gland, and the exact diagnosis may depend upon the impression of the individual surgeon.

Branchiogenic carcinoma. The belief that cancer can arise in embryonic or vestigial remnants of the branchial clefts dates from von Volkmann (1882). In the human embryo, the structures of the face, neck, pharynx, and larynx develop from the branchial apparatus. The first cleft forms the external auditory meatus and the remaining clefts or pharyngeal pouches give rise to the tympanic cavity, the pharyngotympanic tubes, the tonsillar pits, the thymus and parathyroids. It is believed that an irregularity in the closing of these branchial clefts results in reduplication of organs or in fistulous tracts, epidermoid or dermoid cysts, blood and lymph cysts. Although malignant tumors theoretically may arise in any of these vestigial structures, nevertheless, a diagnosis of branchiogenic carcinoma can be made only by exclusion, in our opinion.

Ewing, in discussing this subject, states that after the possibility of metastatic carcinoma, primary endothelioma and carotid body tumors have been ruled out, "there remains a group of apparently primary carcinomas of the cervical lymph nodes whose origin is obscure, and some of these may be derived from the endodermal epithelium of branchial cysts." Others have doubted the existence of branchiogenic cancer. As early as 1892, Sutton, in his discussion of mouth and pharynx cancer wrote as follows:

"One of the facts connected with epithelioma of the mucous membranes of the mouth . . . is the extraordinary size which the infected lymph glands in the neck sometimes attain, whilst the primary ulcer scarcely exceeds 1 cm. in diameter. This is worth bearing in mind because an enlargement of a cervical lymph gland in individuals past middle age should always induce the surgeon to examine the various recesses of the mouth and fauces for small, inconspicuous epitheliomatous ulcers and with every care, they sometimes escape detection during life. It is necessary to emphasize this because a good deal has been written about "branchiogenic cancer" or as it is sometimes called, "malignant cyst" of the neck. . . . Some writers are of the opinion that these are primary epitheliomata arising in remnants of branchial clefts. My belief is that, in most of the cases, these gland masses are secondary to epithelioma originating in recesses of the pharynx or nasopharynx and the theory that they arise in remnants of branchial clefts is pure fiction."

In the head and neck clinic at Memorial Hospital, the diagnosis of branchiogenic carcinoma in any individual case is viewed with skepticism and is never made even tentatively except under the following conditions: (1) The patient must have survived at least 5 years free of disease; (2) treatment must have been directed only to the cervical tumor situated along the line of embryonic branchial clefts (i.e., between the external auditory meatus and the midneck, in the line of the great vessels); (3) histologically, the tumor must have been squamous or epidermoid carcinoma.

We have observed too many cases in which a primary lesion in the mouth or pharynx appeared only after 2 or 3 years to consider seriously as branchiogenic carcinoma any malignant tumor mass in the neck, simply because no other adequate explanation is immediately available. A common example of an erroneous picture found in single case reports in the literature on branchiogenic carcinoma reveals a succession of events about as follows: A surgeon is consulted by a patient because of a cervical mass. The patient is then referred to a nose and throat specialist (probably not greatly interested in cancer). A report is returned stating that there is no growth in the mouth or pharynx and is accepted as conclusive. From then on, the physician does not believe it necessary to

make any further examination of the mouth or pharynx. The cervical mass is removed, diagnosed histologically as epidermoid carcinoma and *ergo* the case is recorded as branchiogenic carcinoma.

During the period covered by this report (1933–1937), there were 55 cases on our service in which the only complaint was of a cervical mass, in which the histologic diagnosis was epidermoid or squamous carcinoma and in which no primary was ever found. Only 8 of these have we finally diagnosed as branchiogenic carcinoma (based on fulfillment of the criteria mentioned). Even these are not indisputable, since it is at least theoretically possible that in some, the undiscovered primary lesion may have been caught and sterilized in the field of radiation to the cervical mass. In the remaining 47 cases, the patients are either dead of cancer or lost track of. Since none of these latter cases were followed for a satisfactory period of time (at least 5 years), they have all been diagnosed as "carcinoma, metastatic to neck—no primary found."

A review of the literature on branchiogenic carcinoma is rather confusing and unsatisfactory.[1] In most cases, the conclusion that no primary lesion exists is based upon single examinations of the mouth and pharynx. We have not found any reported case of branchiogenic carcinoma with a 5 year follow-up with the patient free of disease following treatment for cervical masses.

Carotid body tumor. In a discussion of the differential diagnosis of cervical tumors, the subject of carotid body tumors must, of course, be included. On the other hand, this tumor is so rare that it need scarcely be considered from the practical standpoint in patients complaining of cervical tumors. A special study of this growth by one of our staff (Dr. William S. MacComb) revealed only 159 definitely proved cases reported in the literature in addition to the 6 cases observed (but not reported) at the Memorial Hospital. Carotid body tumors are always situated at the position of the carotid bifurcation—an observation of little diagnostic significance, since this area is also the site of the lymph node group (the subdigastric) most frequently involved by metastatic cervical cancer. An oft mentioned and we believe, overemphasized diagnostic sign of carotid body tumors is their alleged immobility in the vertical plane. Enlarged lymph nodes lying on the internal jugular vein are also relatively immobile in the vertical plane.

The only significant clinical characteristic of carotid body tumors from the diagnostic standpoint in our opinion is a pronounced and relatively superficial arterial pulsation. After the tumor has reached a diameter of 4 to 5 centimeters, it tends to grow deeply mesial to the common carotid artery, and the pulsation of this artery and its branches can then be made out on the superficial surface of the tumor. In the smaller tumors (2 to 2.5 centimeters in diameter), the superficial position of the artery may not be evident except after surgical exposure when the location of the tumor directly in, and also deep to, the crotch of the artery is immediately apparent.

Dr. Fred Stewart of Memorial Hospital has made a histologic diagnosis of carotid body tumor on aspiration biopsy in 2 cases in the past year. The correct preoperative diagnosis of this tumor is important before treatment, since the necessary surgical exci-

[1] Typical but by no means unique examples of unwarranted case reports of branchiogenic carcinoma are the following:

Lillie Cox and Teufel report the case of a man, aged 55, with an "indurated ulcer of the lower lip" and a "hard, tender gland" in the left submaxillary region. Both lesions were excised and examined histologically. The ulcer of the lip was diagnosed as "epithelioma, grade I" and the submaxillary tumor as "malignant cyst, grade III." A few months later, a second "malignant cyst" was removed from the right submaxillary region. Two and one-half years later, a third "cyst" was removed from the submental region. The latter was also found to be a "malignant cyst." The authors disregard the fact that the clinical history was typical of cancer of the lip with cervical metastases. Attaching great significance to the difference in grading of the tumors of the lip and neck, respectively, as reported by the pathologist, the authors conclude that the cervical tumors were "multiple branchiogenic carcinomas" arising in the second branchial and the "mesobranchial" (*sic*) clefts, respectively, in a patient with cancer of the lip.

A second example of an unwarranted case report of branchiogenic carcinoma with an even more ingenious explanation is that of Vokoun. He reports the case of a woman, aged 44, who sought medical advice because of dysphagia of 4 months' duration. He states that a diagnosis of "tuberculosis of the larynx" had previously been made for the reason that "the larynx had a peculiar pallor of the roof—a condition many nose and throat men consider tuberculous." The author states that "under the right mandible, deep in the neck was a tender, firm, fixed mass the size of an olive, directly beneath the angle of the jaw." A roentgenographic examination was made with the patient swallowing a barium mixture and "with considerable difficulty, she managed to force some of the mixture past the esophagus, which showed a constriction opposite the area of the tumor in the neck." After a preliminary gastrostomy, the cervical mass (the size of an olive) was surgically exposed and a specimen was removed for biopsy. The histologic examination revealed "sections of tumor tissue, embryonal in form, highly malignant in character."

Although the history and clinical setting were typical of cancer of the hypopharynx and upper end of the esophagus with cervical metastases, and despite the fact that a cervical tumor "the size of an olive" could hardly by itself have caused dysphagia of 4 months' duration, nevertheless, the author concludes that this was a "carcinoma arising from an epithelial rest in an obliterated branchial cleft."

sion or ligation of the internal carotid carries such a high operative death rate, and the average clinical course is so benign in the untreated case that we believe this tumor should usually be considered a *noli me tangere.*

Primary tumors of soft parts of the neck (excluding lymph nodes). The soft parts of the neck may give rise to practically any of the various tumors of the nerve, muscle, fascial and vascular tissues, and when such growths are situated along the line of the internal jugular vein, they may present difficulties in the differential diagnosis of metastatic cervical cancer. The superficial character of some of these growths or their origin within an anatomic structure such as the sternomastoid muscle may give a clue to their character. In all such cases, the diagnosis will ultimately depend upon the histologic report. Aspiration biopsy may conclusively settle the question in some of the cases, and in others, it may be necessary to make an incisional biopsy. From the practical standpoint, it is important to realize that the incidence of primary soft part tumors of the neck is rare as compared to metastatic cervical cancer.

Acute infection. A common error in clinical diagnosis is to mistake cervical metastatic masses for inflammatory hyperplasia of lymph nodes. On this basis, sepsis in the tonsils or about the teeth is often held responsible and therefore the tonsils are often removed or teeth extracted. The nose and throat clinics where the excised tonsils are subjected to routine histologic examination discover many cases of primary cancer of the tonsils in this manner. When the primary growths are large, there is invariably residual cancer in the tonsillar fossa following tonsillectomy. The frequency with which an error in diagnosis of chronic tonsillitis is made in cancer of the tonsil is illustrated by the following observation made at Memorial Hospital. In a series of 157 consecutive cases of patients with cancer of the tonsil admitted to Memorial Hospital, 15 (10 per cent) had had simple tonsillectomies performed prior to admission as a result of a clinical diagnosis of chronic tonsillitis with cervical lymph node enlargement.

Similarly, in cancer of the base of the tongue, about 30 per cent of the patients applying to Memorial Hospital complain only of a cervical tumor, that is, a cervical metastasis. Over a 4 year period, we have observed 8 instances of cancer of the base of the tongue in which tonsillectomies had been performed within a month prior to the patients' first appearance at Memorial Hospital. In these cases, it can be fairly assumed that the operating surgeon attributed the cervical lymph node enlargement to sepsis from the tonsils. It is also probable that in these cases, the unrecognized primary lesion in the base of the tongue must have been pushed aside to facilitate exposure of the operative field for the tonsillectomy.

When carious teeth are considered responsible for enlargement of cervical lymph nodes, the patient is usually referred to a dentist for extraction. The dentist naturally accepts the diagnosis of the physician and the patient ordinarily remains under his care for several weeks or months before any other attempt is made at further diagnosis.

While enlargement due to hyperplasia of regional lymph nodes can occur as a result of local sepsis, it is seldom that there is slow, gradual enlargement without suppuration. In our experience at the clinic in Memorial Hospital, we rarely find it necessary to make a diagnosis of inflammatory hyperplasia of lymph nodes. In this connection, it is necessary to distinguish a slight (2 to 2.5 cm. in diameter) soft, tender enlargement of the cervical lymph node which occurs in acute tonsillitis, and the slow, progressive, firm enlargement to several centimeters in diameter which occurs as a result of metastasis. It is of course not possible to estimate the relative frequencies of inflammatory hyperplasia and metastatic cancer as a cause of cervical tumors, but it is significant that such unprejudiced observers as Cecil, in his discussion of inflammatory cervical lymph node enlargement, confines his observations to the diseases of childhood (scarlet fever, measles, etc.). In the adult, an asymmetrical enlargement of a nontender lymph node resulting from sepsis is undoubtedly rare and should not be considered until cancer is ruled out.

Tuberculosis. Next to cancer, the most common cause of chronic asymmetric enlarge-

ment of cervical lymph nodes is tuberculosis. Such patients are frequently referred to the Memorial Hospital with a tentative diagnosis of cancer. On the other hand, the erroneous diagnosis of tuberculosis in cases of metastatic cancer is rarely made by the first examining physician. When tuberculous cervical lymph nodes have been present since childhood with a history of suppuration and discharging sinuses, there is, of course, no reason for confusion in diagnosis. Rapidly enlarging, bulky, unilateral, asymmetric enlargement of cervical lymph nodes, even in childhood, is more likely to be cancer than tuberculosis. One of us (H. M.) has discussed this subject as related to childhood cancer in a previous publication (11). On the other hand, tuberculous enlargement of cervical nodes sometimes appears in the adult with a history and physical findings identical with that of cancer, and in these patients, the correct diagnosis can be made only by biopsy.

Syphilis.[1] From the standpoint of diagnosis in mouth and pharyngeal cancer, the question of syphilis is the source of more confusion and error than is any other disease, and one cannot escape the conclusion that in present day medical education, at least some aspects of the syphilis problem have been overemphasized. From the histories of mouth cancer patients before coming to a cancer clinic, there appears to be a widespread, erroneous belief that syphilis is a frequent cause of asymmetric, bulky enlargement of cervical lymph nodes. Such a phenomenon is not discussed by syphilologists and has never been observed at Memorial Hospital. In the present report, we are concerned only with the diagnosis of cervical metastasis, and, in this connection, we are of the opinion that there is no logical reason why any well informed physician should ever consider the possibility of syphilis in the presence of an asymmetric, bulky enlargement of a lymph node in any part of the body. In the Head and Neck Clinic at Memorial Hospital where about 1500 new cases of cancer of the head and neck are seen yearly, no instance of cervical lymph node enlargement due to syphilis alone has ever been proved.

Branchiogenic and thyroglossal cysts. The most common site of origin of branchiogenic cysts is at about the level of the greater cornu of the hyoid bone. Confusion in diagnosis is likely to occur because of the proximity of the subdigastric lymph nodes and the fact that these nodes are more frequently involved by metastatic cancer than is any other cervical lymph node group. Sometimes these cysts are thin-walled and smooth of contour, slightly fluctuant on palpation, and in such cases, the cystic character may be fairly obvious on physical examination. In other cases, the wall is thickened, sometimes almost a centimeter, and in these, the consistency is rather firm on palpation and cannot be distinguished from solid masses. In the latter, the clinical picture is almost exactly that of cervical metastatic cancer, but in any case if the correct procedure of clinical investigation is followed, these cases will present no difficulties in diagnosis.

If no primary lesion is found on examination of the mouth or nasopharynx, the tumors should be aspirated at the first visit. The thin-walled cysts are usually filled with a straw-colored fluid and will completely collapse on aspiration. The diagnosis, therefore, will be clearly established. Arrangements can then be made for the surgical excision after a

[1] Two forms of lymph node enlargement, always of moderate degree—bilateral and symmetric, are discussed by syphilologists (5, 6, 17, 19). The first form is that which occurs in the regional lymph nodes at the time of the primary chancre. The second is the generalized lymph node enlargement coincident with the skin rash in the secondary stage, when considerable diagnostic significance is attributed to the palpability of certain lymph node groups, such as, epitrochlear, occipital, and posterior cervical. According to Keyes, the symmetric lymph node enlargement of syphilis usually disappears about 1 year following the primary chancre and from then on is rare.

Most syphilologists do not clearly define what they mean by lymph node enlargement, however, and it appears to us that they consider even slight palpability to be abnormal. Friedlander points out that unilateral or isolated lymph node enlargement has no significance in the diagnosis of syphilis, although he believes that generalized enlargement is of great significance in the diagnosis of this disease. He concedes, nevertheless, that between 25 per cent and 50 per cent of normal individuals have palpable lymph nodes even in such supposedly significant areas as the epitrochlear and occipital nodes.

Stokes has reported gumma to occur in lymph nodes and to produce unilateral cervical tumors in colored people only. We raise the question here as to whether most of these supposedly gummatous lymph nodes reported by Stokes were not actually metastatic cervical cancer in negroes who also had syphilis.

A positive Wassermann test often leads to a diagnosis of the syphilitic nature of the primary lesion or of the metastases in mouth and pharyngeal cancer. Such erroneous diagnosis are most likely to occur in cancer of the tongue, where in about 30 per cent of all cases, a pre-existing syphilitic glossitis with a positive Wassermann test has been one of the main factors in the etiology of the malignant growth. An incorrect diagnosis of syphilis *alone*, based on the positive Wassermann test, is also likely to occur in the colored race afflicted with mouth or pharyngeal cancer, since the incidence of syphilis is high among these people. In the presence of a lesion resembling cancer, the Wassermann test should be completely disregarded until a histologic diagnosis has been made.

In brief, the moderate bilateral enlargement of all superficial lymph nodes, which is characteristic of syphilis, bears no resemblance to the asymmetric, bulky, unilateral enlargement of a single node or group of nodes in metastatic cancer.

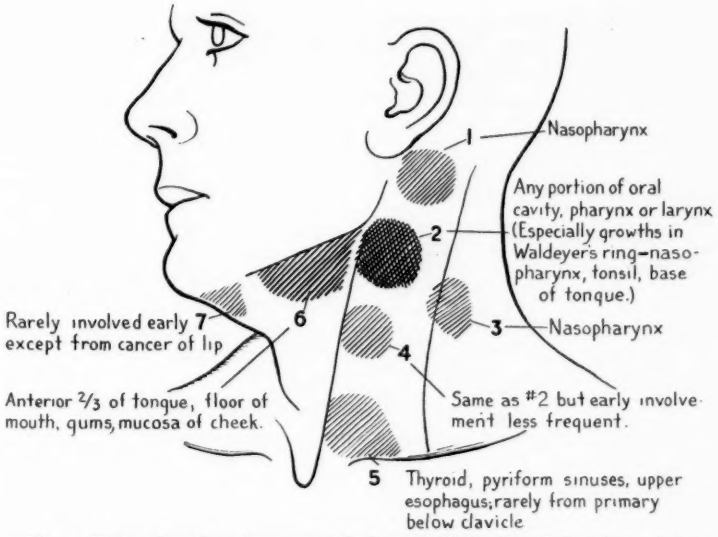
1 Nasopharynx
Any portion of oral cavity, pharynx or larynx (Especially growths in Waldeyer's ring–nasopharynx, tonsil, base of tonque.)
2
3 Nasopharynx
4
Same as #2 but early involvement less frequent.
Rarely involved early except from cancer of lip
7
6
Anterior 2/3 of tonque, floor of mouth, gums, mucosa of cheek.
5 Thyroid, pyriform sinuses, upper esophagus; rarely from primary below clavicle

Fig. 2. Various lymph node groups with the most likely sites of the primary lesions which may cause the metastases.

week or two when the cyst has refilled so as to be more easily handled surgically. The thick walls are due to a lymphoid hyperplasia, and the aspirated contents will consist of serous or mucoid fluid with desquamated epithelial débris. In these cases, the collapse of the cyst will be only partial, but the diagnosis and method of treatment by surgical excision is about the same.

Thyroglossal cysts occur always in the midline of the neck, either above or just below the level of the hyoid bone. When situated above the hyoid, they could conceivably be confused with metastatic submental lymph nodes. Thyroglossal cysts are frequently referred to cancer clinics for diagnosis.

DISCUSSION

The clinical data used in this report have been assembled from the case records of a variety of the many anatomic forms of cancer. These data have been analyzed and correlated to provide the broad perspective which we consider essential to the full understanding of a frequently encountered and rather complex clinical problem, namely, that of cervical metastatic cancer of obscure origin. In such cases, even though the histologic character of the growth has been established, treatment can rarely be permanently effective unless the location of the primary tumor is also discovered and proved histologically. One must concede that both the accepted methods of treatment (surgery and radiation) are strictly local in action and that to be safe and useful, they must be restricted to the volume of the primary growth and all metastases. For this reason, it is axiomatic that cancer can scarcely ever be cured without a complete anatomic diagnosis as to the site of the primary growth. The only and largely theoretical exceptions to the rule would be those cases in which an undiscovered primary growth might fortuitously be included in the field of effective surgery or irradiation, purposefully directed only toward demonstrable metastases. In the final analysis, however, there can be little question but that almost all patients whose primary lesions remain silent and undiscovered are doomed to die of cancer. Only if and when a systemic remedy for cancer is discovered will it be possible to cure this disease without regard to the primary site of the growth.

At this point in the discussion, it seems pertinent to summarize the most common errors

in clinical management which lead to delay in or failure of a complete diagnosis in cases of cervical metastasis from silent primary growths. These errors may be briefly summarized as follows:

COMMON ERRORS IN DIAGNOSTIC PROCEDURE IN CASES OF CERVICAL TUMORS

1. Failure to recognize the probable cancerous nature of most cervical tumors in the adult, and as a result, the treatment or observation only of such tumors as benign (inflammatory, tuberculous, syphilitic, etc.) without recourse to histologic diagnosis.
2. Failure to recognize the probable metastatic character of histologically proved malignant cervical tumors.
3. Failure to examine the mouth and pharynx for silent primary lesions of cancer in all cases of undiagnosed cervical tumors.
4. Failure to appreciate that one or even several examinations of the mouth and pharynx, even by highly competent and experienced examiners, does not permanently preclude the possibility of small primary lesions of cancer which will eventually become obvious.
5. Failure to realize that incisional biopsy should be used only as the last resort and never as the initial diagnostic procedure in cases of cervical tumors.

It also seems useful to us to outline the proper order of procedure for diagnosis in such cases. This procedure may be summarized as follows:

METHOD AND ORDER OF PROCEDURE FOR DIAGNOSIS OF PATIENTS COMPLAINING ONLY OF CERVICAL TUMORS

First visit

1. Obtain a clinical history with particular attention to disregarded symptoms such as:
   a. Deafness, ringing or stuffiness in one ear.
   b. Slight soreness in the mouth or throat or difficulty in swallowing.
   c. Obstruction of one nasal cavity.
   d. History of an operation (or treatment) in the mouth or pharynx at some previous time, even several years before.
2. Note the position of the cervical tumor and consider the probability of its being an enlarged lymph node. From the position of the node, determine the most likely site of the silent primary lesion (see Fig. 2).
3. Carefully examine the mouth and pharynx with headlight and throat mirror.
4. If no primary lesion can be demonstrated readily, consider the indications for biopsy from such areas as:
   a. A partly obliterated fossa of Rosenmueller in the nasopharynx.
   b. Asymmetrical enlargement of one tonsil or an indurated area within a tonsil.
   c. Asymmetrical heaping up of lymphoid tissue at the base of the tongue.
5. Examine the thyroid for the presence of a small primary tumor.
6. Make an aspiration biopsy of the cervical tumor.
7. Consider indications for radiographic or endoscopic examination of the pyriform sinuses and the upper end of the esophagus.

Second visit

8. If the aspiration biopsy report is anaplastic carcinoma, re-examine particularly the nasopharynx, the tonsil, and the base of the tongue. If the report of the aspiration biopsy is negative in character, repeat the aspiration once or more.
9. Correlate all physical, radiographic, endoscopic and histological data.
10. After all other diagnostic resources have been exhausted, consider complete excision of the cervical tumor or of one of several nodes for histologic examination.
11. If no primary lesion can be disclosed, treat the cervical tumor or tumors and continue the search for a primary lesion by thorough examination of the mouth and pharynx at monthly intervals for the first year or two and at slightly longer intervals for at least 5 years before considering the diagnosis complete.

So long as a portion of the medical profession remains satisfied with such diagnoses as "carcinoma of the neck" without thought of the probable metastic character of the growth and the location of the primary lesion, and so long as death certificates giving only the site of the metastatic cancer are signed by physicians and accepted for registration and record by health authorities, it is obvious that little progress will be made in the interests of those patients who complain only of cervical tumors and whose primary growths are silent.

Common errors in diagnosis and treatment of initially symptomatic cervical metastatic cancer. In our list we mention several common errors in procedure which are found to be responsible for delay or absence of complete diagnosis in cases of cervical metastatic cancer with silent primary growths. Since these misconceptions and errors in procedure have been repeatedly stressed in the foregoing text, it seems to us that beyond their listing for reference, no further elaboration is required here.

Plan of procedure for diagnosis in cases of patients complaining only of cervical tumors. From the foregoing analysis of clinical data, one should be able to formulate a logical system and order of procedure for the differential diagnosis of cancer in cases of cervical tumors. Such a plan has been outlined. It seems to us, however, that the greatest obstacle to the general acceptance and use of such a scheme is the difficulty in demonstrating its necessity. The clinical data which we have presented in this report force one to the conclusion that too many physicians are unfamiliar with the early clinical course of cancer and unmindful of the necessity of early and complete anatomic diagnosis, if the patient is to have a reasonable chance of cure. When an error or delay in diagnosis of cancer occurs, the responsible physician himself seldom has to face the tragic consequences to the end. That illuminating experience is reserved for the staffs of the cancer clinic or the home for incurables and last but not least for the patient himself and his family. For this reason we have laid so much emphasis on the frequency of the characteristic clinical course of initially symptomatic cervical metastasis.

Although the detailed procedures in our outline may at first appear to be too numerous and complicated, a more careful consideration and trial will prove that they are not difficult to carry out. With such an approach, the silent primary growth is often disclosed within 2 or 3 minutes. Even if the primary growth is more obscure, the details of the examination on the first visit, including an aspiration biopsy, can be carried out within 15 minutes. Radiographic and endoscopic examination will usually require a second visit. A complete understanding of this problem requires the conviction that a primary lesion *probably exists somewhere*, even though it cannot be disclosed at first. Viewed in this manner, the diagnosis of cervical cancer is considered tentative only until a primary lesion is discovered or until the patient has survived for 5 years following treatment to the cervical tumor alone.

SUMMARY

Cervical metastasis as the first and for a time the only symptom of cancer is discussed from the standpoints of definition, incidence, anatomic location of the silent primary growths, subsequent clinical course and differential diagnosis. The importance of early discovery of the silent primary tumor is emphasized. Common errors in management of and a logical plan of procedure for the differential diagnosis of cancer in cervical tumors are discussed.

CASE REPORTS

CASE 1. Delay in diagnosis in a case of cancer of the nasopharynx erroneously diagnosed as "Hodgkin's disease."

Charles N., male, aged 55 years, was first seen in the admitting office of Memorial Hospital in October, 1942. About 4 months previously he had first noted a "lump" in his left upper neck (Fig. 3) not associated with any subjective symptom. A few weeks later he went to a hospital where an incisional biopsy was made and a histologic diagnosis of "Hodgkin's disease" returned. He was then referred to the Memorial Hospital.

In the admitting office of Memorial Hospital the question of cancer of the thyroid was raised, but no examination of the nasopharynx was made. A letter was written asking for a loan of the slide but when it was received after a week's delay the pathologist pronounced it "unsatisfactory for diagnosis." A second incisional biopsy of a cervical node was made in the admitting office and a report of "metastatic carcinoma" was returned. On the basis of this report re-examination was made of the upper respiratory and alimentary tracts, and the nasopharynx was found to be filled with a bulky tumor which was causing no symptoms. The patient was then referred to the head and neck service where a biopsy specimen was removed from the nasopharynx. The diagnosis was "anaplastic epidermoid carcinoma."

The delay in diagnosis occurred in this case because the admitting officer of the Memorial Hospital was influenced by the previous erroneous diagnosis of "Hodgkin's disease" and failed to realize that the clinical findings were more typical of metastatic cancer than of Hodgkin's disease. If a thorough examination had been made at the time of his first visit to Memorial Hospital the primary lesion in the nasopharynx would undoubtedly have been discovered, a biopsy specimen removed, and the correct diagnosis established immediately without the necessity of the eventual removal of an enlarged cervical node. In this case the proper treatment for cancer of the nasopharynx was unnecessarily delayed

for about 10 days following application to the Memorial Hospital.

CASE 2. Delay in diagnosis in a case of epidermoid carcinoma of the pharyngeal wall in a patient complaining only of a cervical tumor.

Lorraine L., female, aged 40 years, was first seen in the admitting office of Memorial Hospital in July, 1942. She stated that 6 months previously she had first noted swellings in both sides of the neck (Fig. 4) which had slowly progressed. No other symptoms were elicited. Her family doctor had examined her on several occasions and had finally referred her to the Memorial Hospital.

In the admitting office of the Memorial Hospital a clinical diagnosis of Hodgkin's disease was made and an aspiration biopsy was performed with a report of "lymphoid tissue only." An incisional biopsy was then carried out and a diagnosis of "transitional cell carcinoma" was returned. With this report, the patient was referred to the head and neck clinic where on the first examination a nonulcerated, bulging tumor was found on the lateral pharyngeal wall extending up into the nasopharynx. A biopsy from this mass was reported as showing "transitional cell carcinoma."

Because of a similarity in the clinical appearance to some cases of Hodgkin's disease, no adequate examination of the upper respiratory and alimentary tracts was made in the admitting office. The correct diagnosis was made only after an unsuccessful aspiration biopsy and an incisional biopsy although the pharyngeal tumor was obvious on inspection of the pharynx. Had the admitting officer realized that the symptoms were more characteristic of cervical metastatic cancer than of Hodgkin's disease a more careful examination would have been made at the time of the first visit and the primary lesion in the pharynx immediately disclosed. The avoidable delay in diagnosis in this case was only about 2 weeks but properly managed the diagnosis could have been made without resorting to removal of a cervical node.

CASE 3. Unavoidable delay of 18 months in the complete diagnosis in a case of adenocarcinoma of the base of the tongue in a patient complaining only of a cervical tumor.

George P., male, aged 64 years, was first seen in the admitting office of Memorial Hospital in April, 1934. Six months prior to admission he had noted a swelling in the upper left neck (Fig. 5). After a delay of about 5 months he applied for examination at another hospital, where a clinical diagnosis of cancer was made and he was immediately referred to Memorial Hospital without any further examination.

On application to the Memorial Hospital he was referred directly from the admitting office to the head and neck clinic where no primary lesion was found after examination of the upper respiratory and alimentary tracts. An aspiration biopsy of the cervical tumor was then made and a report returned of "carcinoma—suspected salivary gland origin." The cervical mass was treated by a combination of x-ray and radium and a systematic search was continued for a primary lesion. The oral cavity and pharynges were repeatedly examined at intervals of about 2 weeks. The patient was bronchoscoped and esophagoscoped and x-ray examinations of the chest and gastrointestinal tract were made.

A year after the first visit, on the 25th routine examination of the upper respiratory and alimentary tracts for a primary lesion, a small, superficial ulcer about 3 to 4 millimeters in diameter was noted at the left base of the tongue. A biopsy specimen was removed from this area and found to be identical histologically with the cervical tumor.

In this case the cervical tumor was believed from the first to be metastatic and a systematic search consisting of a series of about 25 examinations over a period of a year was made for the primary lesion. The primary growth, when discovered, was so small that it probably was not previously discernible to the naked eye.

CASE 4. Delay in diagnosis in a case of squamous carcinoma of the base of the tongue in a patient complaining only of a cervical mass whose diagnosis was missed because no examination of the mouth was made.

John T., male, aged 63 years, first applied to the Memorial Hospital in May, 1933. Four months prior to admission a friend had called his attention to a swelling in the right side of his neck (Fig. 6). Three weeks later he consulted his family physician and was referred to a surgeon, who made an incisional biopsy of the cervical mass. A histologic report of "squamous carcinoma" was returned. The surgeon then referred him back to his family doctor without any examination of the oral cavity, and on the basis of the histologic report the patient was referred to the Memorial Hospital. In the admitting office a bulky primary lesion was immediately discovered in the right base of the tongue.

In this case the patient with a cervical tumor passed through the hands of his family doctor and a surgeon without any examination of the oral cavity for a primary lesion of cancer although the surgeon performed an incisional biopsy of the cervical mass which disclosed cancer. The primary tumor in the

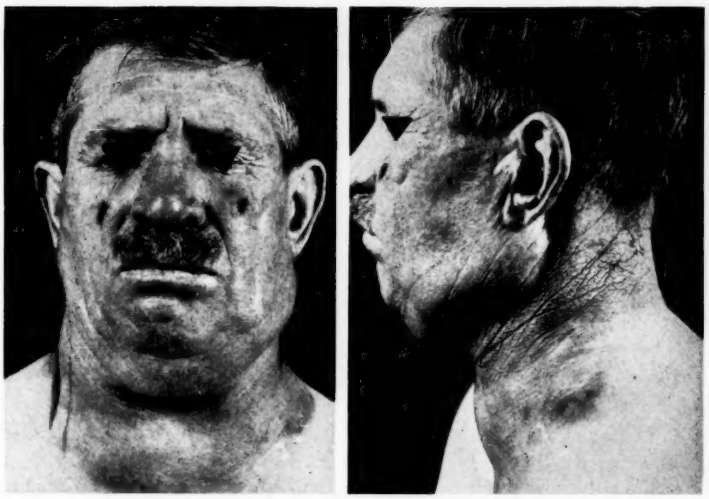

Fig. 3. Case 1, Charles N. Delay in diagnosis in a case of cancer of the nasopharynx at first erroneously diagnosed as Hodgkin's disease. The only complaint was of a cervical tumor and an improperly fixed biopsy specimen was erroneously interpreted as showing Hodgkin's disease.

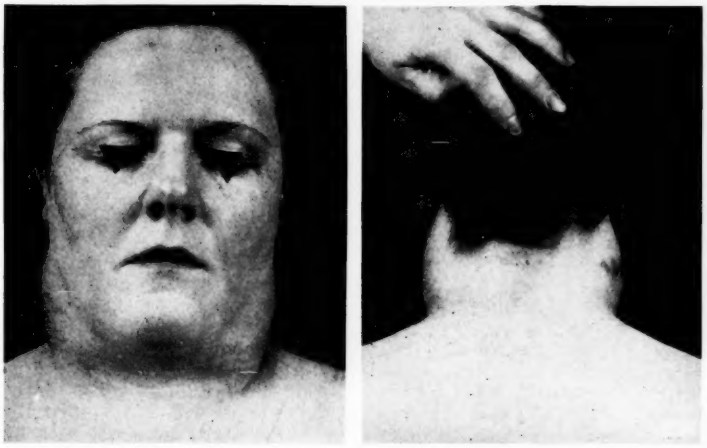

Fig. 4. Case 2, Lorraine L. Delay in diagnosis in a case of epidermoid carcinoma of the pharyngeal wall in a patient complaining only of a cervical tumor. An erroneous clinical diagnosis of Hodgkin's disease was made at first.

base of the tongue was bulky and could have been discovered readily by inspection or even by the exploring finger. The avoidable delay in diagnosis was about 3 months.

CASE 5. Delay in diagnosis in a case of epidermoid carcinoma of the nasopharynx in a physician who complained only of cervical swelling.

John R., male, aged 49 years, the assistant superintendent of a tuberculosis sanatorium, was first seen by one of us (H. M.) in August, 1941. In January, 1941 he had suffered a severe upper respiratory infection which subsided and he returned to his work. In March, 1941 he had suffered another severe upper respiratory infection which was associated with marked bilateral enlargement of the

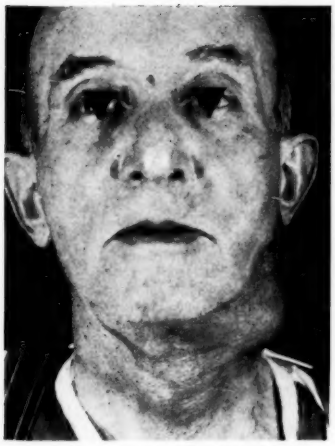

Fig. 5.

Fig. 5. Case 3, George P. Unavoidable delay in the complete diagnosis in a case of adenocarcinoma of the base of the tongue in a patient complaining only of a cervical tumor for a period of 18 months.

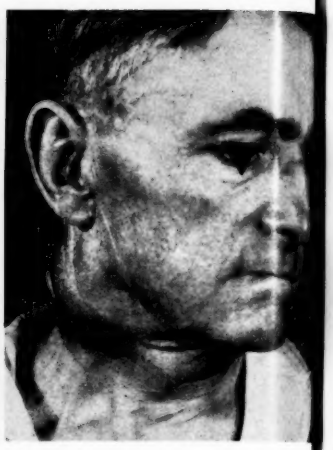

Fig. 6.

Fig. 6. Case 4, John T. Delay in diagnosis in a case of carcinoma of the base of the tongue in a patient complaining only of a cervical mass the diagnosis of which was missed because no examination of the mouth was made.

cervical lymph nodes. It was noted that this lymph node enlargement did not recede when the infection subsided. He was assiduously attended and examined by the staff of the tuberculosis sanatorium who were of the general opinion that the lymph node enlargement was tuberculous in character. The consensus was that he should wait for these nodes to calcify and then have them removed. The cervical swellings progressively enlarged and finally one of his associates urged him to have further investigation made.

After a delay of 8 months from the beginning of symptoms, the patient came to New York for consultation, and bulky, bilateral lymph node enlargement, clinically typical of metastatic cancer, was noted. From the position of the lymph nodes in the upper neck, the nasopharynx was suspected as the site of the primary lesion and examination immediately disclosed a bulky tumor at least 3 centimeters in diameter on the posterior wall. A biopsy from this lesion was reported as "epidermoid carcinoma, grade III."

In this case, the association of ideas, that is, of enlarged cervical lymph nodes and tuberculosis, was a natural one, since the patient and his colleagues were on the staff of a tuberculosis sanatorium. The clinical diagnosis of tuberculosis, unsupported by histologic evidence, was persisted in for about 8 months until the disease progressed to an advanced stage. The patient died 2 years later from widely disseminated cancer. The probably avoidable delay in diagnosis in this case was about 8 months.

CASE 6. Delay of 18 months in diagnosis in a case of epidermoid carcinoma of the nasopharynx in a patient complaining only of cervical nodes.

Russell S., male, aged 35 years, was first seen by one of us (H. M.) in February, 1943. He stated that he had first noticed "swellings" in both sides of the neck about 18 months previously. He had immediately consulted his family doctor who referred him to a surgeon who performed an incisional biopsy. The pathologist returned a report of "lymphoepithelioma." A single examination of the upper respiratory and alimentary tracts by a nose and throat specialist was said to have been negative for any primary tumor. A specimen for biopsy was taken from the left tonsil, which showed only "infected tonsillar tissue." So far as the patient knew, no further examination was made of the mouth or pharynx. He was given a series of x-ray treatments to the neck with some regression. Six months later there was further growth of the cervical tumors and more x-ray treatments were given, this time with little effect. During the fall of 1942, the cervical tumors increased in size and ulcerated through the skin in the submaxillary region, and he remained for some months under the care of his local physician.

At the first consultation by one of us (H. M.) in February, 1943 the patient had no complaint except of the ulcerated cervical tumors. Physical examination revealed widespread subcutaneous tumors in both sides of the neck. In the left submaxillary region, the tumor had ulcerated and fungated through the skin over an area 5 to 6 centimeters in diameter.

Although the patient had complained of no pharyngeal symptoms, examination of the nasopharynx immediately disclosed an ulcerated, fungating lesion at least 2.5 centimeters in diameter on the left lateral nasopharyngeal wall. Specimens for biopsy were removed from the nasopharyngeal tumor and from the ulcerated lesion in the neck. Both were diagnosed by the pathologist as "anaplastic epidermoid carcinoma." The growth was considered too far advanced for curative treatment. The patient died of his disease in March, 1943.

The primary tumor in the nasopharynx might have been obvious or it might have been too small for discovery at the time of the first examination. The true diagnosis of cancer was suspected and confirmed by removal of a cervical lymph node in 1941. So far as could be learned, no systematic attempts were subsequently made to discover a primary lesion, although two series of x-ray treatments were given at intervals of about 6 months. A bulky, primary lesion in the nasopharynx was first disclosed only 7 weeks before the patient's death. The avoidable delay in diagnosis in this case was probably about 18 months.

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EXPERIMENTALLY INCREASED BLOOD SUPPLY TO THE HEAD AND NECK OF THE FEMUR

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MANY of the pathological disturbances of the hip joint are initiated or accompanied by diminution of the normal blood supply to the head of the femur. The principal nutrient arteries in the ligamentum teres or the posterior capsule of the joint become thrombosed or lacerated and, since they are endarteries with little collateral circulation, the nutrition of the head is impaired. The resultant avascular (or "aseptic" or "quiet") necrosis of the head of the femur may be seen in such conditions as fracture of the neck of the femur, traumatic dislocation of the hip, Perthes disease, slipped epiphysis or monarticular hypertrophic arthritis, and, while each infirmity has distinctive clinical signs and symptoms, collectively they possess the common characteristic of an inadequate circulation to the femoral head. On the basis of animal experiments, we have devised an operation for overcoming this localized ischemia and for hastening revascularization in case the necrosis of the head is already present.

In other regions of the body, supplementary circulation to overcome localized ischemia has been successfully provided by transplanting a flap of vascular muscle or omental tissue to the area involved. In experimental animals, we have developed a similar method of transplanting a muscle flap to the neck of the femur in such a way that an auxiliary blood supply can be directed into the neck and head of the femur. This was undertaken because bone which has suffered impairment of normal circulation is not as capable of establishing collateral circulatory paths as are other more vascular tissues and the head of the femur normally receives only a minimal amount of blood.

Since their first reports in 1935, Claude Beck and his coworkers have shown that a pedicle graft of pectoral muscle can be transplanted to the wall of the heart in such a way that anastomoses readily develop between the vascular beds of the graft and the heart wall. In cases of coronary sclerosis, wherein the blood supply to the myocardium is impaired, transplantation of such a muscle flap is followed by marked relief of symptoms. Moreover, Beck demonstrated in experimental animals that blood vessels will penetrate the heart wall across a bridge of adherent scar produced by powdered asbestos as well as through flaps of transplanted skeletal muscle.

In experimental animals, O'Shaughnessy transplanted a large graft of omentum through the left leaf of the diaphragm to the heart wall and demonstrated a vascular connection as promptly as 3 weeks after the operation. This was an adaptation of the old Morison "epiplopexy" operation for the relief of ascites wherein a flap of omentum was transplanted into the muscles of the abdominal wall.

Friedbacher has reported similar experiments in which transplantation of a flap of omentum to the heart wall was followed by the establishment of a rich anastomosis of blood vessels.

Heinbecker and Barton were able to produce a collateral circulation to the heart wall by introducing an irritative material into the pericardium which resulted in adhesive pericarditis. These adhesions were shown to convey small vascular anastomoses into the myocardium.

German and Taffel applied pedicle grafts of temporal or occipital muscle to the brain in monkeys and identified communicating blood vessels from the muscle flap into the cerebral cortex.

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These experiments were made possible by a grant from the Medical and Surgical Memorial Hospital Research Fund, San Antonio.

Fig. 1. Specimen from experimental animal 2 months after muscle flap transplant to anterior surface of the neck of the femur.

Kredel reported 3 cases in which a flap of temporal muscle was transplanted to the dura in cases of cerebral thrombosis. He recommended the operation for conditions in which there is localized ischemia of the cerebral cortex.

In an effort to augment the circulation to the kidneys, various operations have been reported which utilize flaps of omentum transplanted to the external surface of the kidney (Davis et al., MacNider et al., Mansfield et al.).

ANIMAL EXPERIMENTS

In our experiments, we operated upon 28 dogs and transplanted various types of pedicled muscle flaps to the hip to try to establish new vascular connections. Mongrel city pound dogs were used and the animals were of all ages from very young pups to old dogs. The animals were anesthetized with intravenous veterinary nembutal and the usual aseptic

Fig. 2. Cross section of neck of femur in experimenta animal 3 months after muscle flap transplant into defect created in anterior aspect of the neck.

precautions observed. The right hip was operated upon in each case so that a comparison could be made with the normal left hip when the animals were injected at autopsy. When the dogs were sacrificed, the abdominal aorta was divided and a cannula ligated in the distal portion. The inferior vena cava was then opened and the blood vessels of the distal half of the body were flushed with normal saline solution. Immediately the vessels were injected with some radiopaque material such as lipiodol, sodium iodide, or metallic mercury after which roentgenograms were made. The comparative number of blood vessels to each hip could not be distinguished clearly enough to rely on this as an accurate method of appraisal. In one group of animals, the abdominal aorta was injected with India ink so that the capillaries to each hip could be dissected. We found, however, that the most reliable observations were those which were based on the pathological study of sections of tissue taken through the region of the muscle transplant.

In the first type of operation, a hole was drilled from the lateral side of the greater trochanter through the neck and into the head of the femur. A flap of the gluteus medius muscle was then freed and transposed so that the cut end of the muscle projected into the hole in the trochanter. It was anchored by fine wire sutures.

Fig. 3. Diagram illustrating operative approach to the hip which has been used for performing a muscle flap transplant operation.

Fig. 4. Diagram showing dissection of flap of vastus lateralis muscle in preparation for transplantation to the femoral neck.

In the second type of operation, a wider apposition between the muscle flap and medullary cavity was secured by removing the lateral cortex of the greater trochanter so that the flap of the gluteus medius muscle could be anchored directly against a large area of cancellous bone.

In the third and most successful type of operation, a flap of the vastus lateralis muscle was sutured in a longitudinal slot on the anterior surface of the neck of the femur. In this way the vascular muscle tissue was transplanted directly to the neck and base of the head of the femur.

After these operations, the dogs usually protected the involved leg for 5 or 10 days after which they ran about normally with no apparent pain or limp. They were sacrificed at intervals varying from 1 week to 4 months after the operation, and tissue was removed from the region of the transplant for pathological study.

After decalcification *in vacuo* by Wilson technique, the sections removed from the site

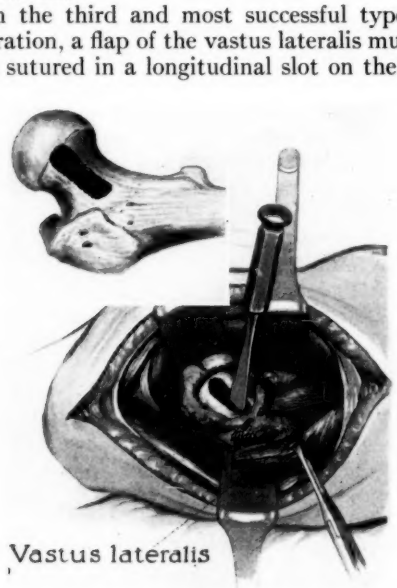

Fig. 5. Diagram of method of preparing slot on the anterior surface of the neck of the femur to receive the muscle transplant.

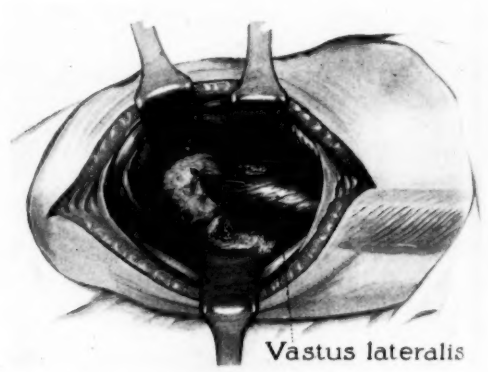

Fig. 6. Diagram showing flap of vastus lateralis muscle sutured into the slot in the femoral neck by means of sutures through the capsule and adjacent ligaments.

of the transplants were stained with hemotoxylin and eosin and studied by Dr. Henry Hartmen, pathologist to the Medical and Surgical Hospital.

He reported: "It was possible to demonstrate blood vessels effecting a direct connection between the perimysium of the striated muscle and periosteum. The line of growing capillaries was distinctly seen extending from the interstitial tissue of the muscle into the periosteum. The vascular reaction in the periosteum and underlying bone provoked by the experimental measures carried out was seen in sections of a high percentage of the specimens. Vascularized fibrous connective tissue connections showed the establishment of an intimate union between the muscle implants and the adjacent bone."

CLINICAL APPLICATION

Since our observation of this type of operation on 28 dogs disclosed that an accessory blood supply could be directed into the hip and since muscle transplants had been shown to convey blood vessels to other portions of the body, we decided to utilize this muscle flap transplant in conditions in which the blood supply to the hip was impaired as the result of disease or injury.

To date, the most useful manner in which this operation has been adapted is in cases of monarticular hypertrophic arthritis and slipped femoral epiphysis. We have been doing a muscle flap transplant to the neck of the femur at the time a vitallium cup arthroplasty was performed for the former condition and in the latter cases when a vitallium Smith-Petersen nail was inserted. Thus far in our observations, we have observed much less persistent pain after cup arthroplasties for hypertrophic arthritis and more rapid fusion of the head and neck when slipped epiphyses are nailed. It is too early to give a final appraisal of these results.

SUMMARY

Muscle flap transplants have been shown by various experimenters to convey accessory circulation to regions of the body involved in impaired vascularity.

Our experiments on 28 dogs revealed that a muscle flap transplant to the neck of the femur directs new blood vessels into the neck and head of the femur.

Many of the common noninfectious conditions of the hip result from, or are aggravated by interference with the normal blood supply to the head of the femur. Correction of this deficiency by an accessory blood supply to the neck of the femur may result in decrease of symptoms and more rapid recovery of normal hip function.

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BACTERIAL FLORA OF FRESH ACCIDENTAL WOUNDS

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DURING war the problems of wound healing are of the utmost importance to both military and civil surgeons. The great increase in the number of industrial and military wounds again emphasizes these problems. After the arrest of hemorrhage and management of shock, the successful treatment of wounds depends largely upon the prevention and control of infection. Failure may result in death, loss of limb, or prolonged or permanent disability. If infection does develop within the wounds further destruction of tissue occurs, and the process of wound healing is suppressed. The usual traumatic wound presents many possibilities of infection. Bacteria from many sources may be introduced into the wound, and may propagate and infect the wound in the presence of devitalized tissue or foreign bodies such as dirt, clothing, missiles, and metal or wood fragments. While it is true that the presence of bacteria *per se* in a wound may not determine the development of infection, the most logical approach to many of the problems of wound infection rests in a knowledge and understanding of the types of bacteria contaminating wounds. As an example, recognition of the presence of Clostridium tetani in infected war wounds led to the development and prophylactic use of tetanus antitoxin to prevent effectively the dreaded and fatal complication of tetanus. Bacteriologic studies of accidental wounds complicated by gangrene, cellulitis, or abscess have indicated the nature of the infecting agents and concentrated our attention and efforts toward their control. In our opinion further bacteriologic studies of fresh accidental wounds will undoubtedly aid in the solution of many of the remaining problems of wound infection either directly or indirectly. Additional information is needed regarding the virulence of bacteria, their biochemical requirements for growth and infection, the chemical nature of their toxins and enzymes, and the various chemotherapeutic agents which may successfully retard their growth.

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MATERIAL

At the Cincinnati General Hospital a study of the bacterial flora of fresh accidental wounds was started in April, 1941, and 99 wounds were studied in the following 10 months. The injuries consisted principally of extensive lacerations and compound fractures. Smaller numbers of human bite, dog bite, gunshot, stab, and burn wounds were also included. Most of the wounded patients required hospitalization.

TABLE I

Type of wound	Incidence
Laceration or avulsion	35
Compound fracture	29
Human bite	11
Dog bite	4
Gunshot (soft tissue)	3
Stab	4
Burns	13
Total	99

In addition to the 3 soft tissue wounds caused by gunshot, there were 3 compound fractures produced by bullets. Many of these cases were street or automobile accidents and were visibly and grossly contaminated. The majority of the cases were seen 3 or more hours after injury, unlike those of Pulaski, Meleney, and Spaeth which were seen within one-half hour. Previous to their admission most of our patients had not had application of either antiseptic solution or dressing.

METHOD

We agree with Meleney that a true index of the type and degree of bacterial contamination can be obtained only by culturing all tissue excised from a wound. In this way the micro-organisms contaminating the surface as well as those deposited in the deeper recesses of the wound are more likely to be detected by cultivation. Material obtained for

culture by swabbing the wound surface frequently is not a representative sample and is therefore often inadequate. Accordingly, in every instance but one the material cultured by us consisted of all the devitalized tissue excised from the wound. This tissue was placed immediately into tubes of preheated and cooling Rosenau's brain dextrose broth and milk medium. For the rapid preliminary detection of Clostridium welchii (1), the milk medium tubes were incubated for 24 hours under anaerobic conditions produced by Wright's modification (17) of the pyrogallic acid technique, Rockwell's solution being used (18).

After incubation of the brain broth culture at 37 degrees C. for 24 hours, a representative sample of it was used to make two blood agar plates for isolation of the various types of bacteria. One plate was incubated aerobically and one anaerobically, the McLeod apparatus being used. Isolated colonies were picked from the aerobic plates within the first 24 to 48 hours, and from the anaerobic within 7 to 10 days. Additional anaerobic plates were made from the brain broth cultures after 7 days' cultivation to catch any slowly developing anaerobic bacteria. During the study it became apparent that it was necessary to hold the brain broth cultures and anaerobic plates for 5 to 10 days to obtain satisfactory growth of such anaerobes as Clostridium tetani and Bacillus melaninogenicum. After isolation of the bacterial strains, their identification was completed whenever possible by morphological and cultural studies.

RESULTS

Bacteria were cultured from all but 4 of the 99 wounds studied. In at least 2 of these 4 instances we believe that a false negative culture was the result of an old faulty incubator which became too hot. In these 2 cultures bacteria were seen in a stained smear, although no growth was obtained on subcultivation.

From 1 to 8 different species of bacteria were cultured from each specimen of débrided tissue, the average being 3.2. Pure cultures were found to be present in only fifteen instances.

TABLE II

Bacterial types	Strains	Incidence %
Staphylococci	101	86
Streptococci	61	54
Enterobacilli	20	20
Clostridium welchii	39	39
Other clostridia	7	6
Bacteroides	11	11
Anaerobic and microaerophilic streptococci	8	8

Eighty-six per cent of the wounds were contaminated with 101 strains of viable staphylococci. Of these strains 37 were hemolytic and 64 were nonhemolytic. Unfortunately during the first part of this study we did not classify these staphylococci as to their ability to coagulate human plasma. More recently we have found that approximately 20 per cent of the hemolytic strains isolated from this source were coagulase positive varieties (5). Hemolytic staphylococci were found in 37 per cent of the cases, being rather evenly distributed throughout the various types of wounds. Fifty-four wounds were found to be contaminated by 61 viable strains of aerobic streptococci. Of these 13 were hemolytic, 33 nonhemolytic, and 15 green producing.

TABLE III

No. and type of wound	Incidence of staphyococci Hemolytic	Nonhemolytic
35 Lacerations	10	28
29 Compound fractures	9	19
11 Human bites	5	5
4 Dog bites	2	1
3 Gunshot	1	2
4 Stab	2	2
13 Burns	8	7
	37	64

Clostridium welchii was found in 39.4 per cent of the fresh accidental wounds as is shown in Table IV. This organism was present in 30 per cent of the soft tissue wounds, in 38 per cent of the compound fractures, and in 85 per cent of the burns The last 24 strains of Clostridium welchii isolated from these wounds were tested for animal pathogenicity. Subcutaneous innoculations of 0.5 cubic centimeters of a 24 hour brain broth culture were made in the abdominal wall of guinea pigs. In every instance an area of crepitant cellulitis developed, but the size and extent varied considerably with the various

strains. Gangrene and ulceration were caused by 22 strains and death of the animals by 14.

TABLE IV

No. and type of wound	Incidence of Clostridium welchii
35 Lacerations	10
29 Compound fractures	11
11 Human bites	5
4 Dog bites	2
3 Gunshot	0
4 Stab	0
13 Burns	11
	39—39.4 per cent

Clostridium tetani was isolated in 2 instances; from a compound fracture and from a deep laceration. Both strains were toxigenic.

ANALYSIS OF STUDY

There is still considerable dispute over the question of whether or not all accidental wounds are contaminated by bacteria. Many reports give an incidence of negative wound cultures of from 7 to 41 per cent. Veraart and Drenth found that 41 per cent of the wounds studied were sterile; Dimitza and Gutscher found 21.7 per cent, Levaditi (9) found 7 per cent, Miles et al. found 9 per cent and Hare (7, 8) found 11.1 per cent. An analysis of these studies indicated that the specimens cultured were often obtained from swabs of wound secretion and not from débrided tissue. On the other hand, the reports of Sas, and Pulaski, Meleney, and Spaeth (15) indicate that all accidental wounds are contaminated. For all practical purposes we believe that all accidental wounds, particularly extensive ones, are contaminated to some degree by bacteria.

In this study the bacterial flora of wounds was mixed and varied. From 1 to 8 different species of bacteria were cultured from each wound. Pure cultures were found in only 15 instances.

Two general types of bacteria contaminated these fresh wounds, one consisting of those of intestinal origin, and the other of those originating from the human upper respiratory tract, skin, and infected wounds.

The first group consisted of both aerobic and anaerobic intestinal bacteria which reached the wound either directly through contamination by feces or indirectly by fertilized soil or wool clothing (2, 6, 11). In addition to other intestinal bacteria, cultivated and polluted soils may contain as many as 10,000 Clostridium welchii spores per gram of soil (21). This group included the more important anaerobes such as Clostridium welchii, and others of the gas gangrene group, Clostridium tetani, bacteroides, and anaerobic streptococci. Of lesser importance were the aerobes such as Bacillus coli, Bacillus aerogenes, Bacillus proteus, Bacillus alkaligenes, and the enterococci. In general the pathogenicity of members of this group was low but the presence of devitalized tissue greatly enhanced their virulence.

The second group was composed of staphylococci and streptococci, either aerobic, anaerobic, or microaerophilic. The majority of these bacteria were also of low virulence for experimental animals in pure culture, but certain hemolytic varieties were particularly pathogenic. The sources of these bacteria have been shown (7, 8, 13) to be the human respiratory tract, the skin of patient or personnel treating the wound, and the air or instruments contaminated by nearby infected wounds. Wound contamination by this group may produce cellulitis, abscess, lymphangitis, osteomyelitis, ulceration, bacteriemia, or septicemia.

In this study there was a rather high incidence of hemolytic staphylococcic and hemolytic streptococcic contamination of fresh wounds. Because of the nature of this hospital and of its accident patients, a large number of unmasked persons may come into contact with a wound including individuals administering first aid, police, receiving ward personnel, as well as nurses, physicians, and medical students. One out of every 3 wounds in this series was already contaminated by hemolytic staphylococci and 1 out of every 8 by hemolytic streptococci at the time the patient reached the treatment or operating room. It seems evident that in hospital practice secondary contamination of open wounds by pyogenic cocci has often occurred before definitive treatment is begun. This observation is the strongest argument we know for the application of a sterile gauze dressing to

all wounds at the earliest opportunity and for the masking of patient and personnel whenever this dressing is removed. Further cross contamination and secondary hospital infection as recently emphasized by Miles and Hare (7, 8) were also seen in subsequent observations of these cases.

The contamination of 39.4 per cent of the wounds by Clostridium welchii is a higher incidence than that described by Sas (14.5 per cent), Dimitza and Gutscher (20 per cent), Levaditi et al. (17 per cent), Pulaski, Meleney, and Spaeth (11.9 per cent), Miles et al. (16 per cent. However, over three-fourths of the 99 wounds studied were extensive, visibly dirty, and three or more hours old. Each of these factors tends to increase the incidence of clostridial contamination. The absence of visible dirt does not rule out the presence of Clostridium welchii by any means, for it was cultured from several apparently clean lacerations and from 5 human bite wounds. The high incidence of Clostridium welchii in burns (86 per cent) was particularly interesting and unexpected and the burned tissue was also found to be grossly contaminated by a large number and variety of other bacteria.

The high degree of wound contamination by anaerobic bacteria suggests certain limitations and dangers in the treatment of compound fractures by the Orr Trueta closed-plaster method. Gangrene may result from pressure and it would seem that unpadded plaster encasement of an extremity should be used only when constant close supervision is possible for at least 24 hours. Many anaerobes are noted for their tendency to burrow and dissect through the subcutaneous and subfascial tissues. In the presence of anaerobic bacterial contamination and residual devitalized tissue resulting from incomplete or inadequate débridement, it is difficult to believe that infection would be prevented simply by reduction of the fracture and prolonged application of a cast. Such doubts seem to be confirmed by the observations of Arnaud and his associates on 600 men wounded in the Spanish Civil War. All had been treated by the closed-plaster method from 15 days to 6 months before. Half of the compound fractures showed mediocre results as evidenced by malunion, nonunion, and infection. All fractures of the femur showed bad results and no wounded joint was without complicating infection. Although many cases demonstrated no clinical signs of infection, many had infective dissection of the subcutaneous and subfascial layers, particularly of the lower extremity. Several cases with similar results treated by this method at the Cincinnati General Hospital have been observed.

SUMMARY AND CONCLUSIONS

Analysis of the results of this study and a review of the recent literature on the bacterial flora of accidental wounds show several significant observations:

1. All war wounds and, in all probability, all accidental wounds are contaminated by bacteria by the time they are seen by a surgeon.

2. The bacterial flora of wounds is mixed and varied. Many different types of bacteria may be found contaminating wounds singly or in combination.

3. The bacteria fall into two main groups, an intestinal group and a pyogenic group. The sources of the former may be human or animal feces, soil, or clothing. The latter originates from the human sources such as the respiratory tract, skin, or other infected wounds.

4. Contamination by the pyogenic group seems to occur in a small proportion of cases at the time of injury, but in a much greater proportion after the time of injury. A considerable degree of secondary pyogenic contamination may occur by the time a surgeon sees a wound of three to six hours' duration. The importance of covering a wound immediately by the application of a sterile dressing is obvious.

5. The high degree of anaerobic bacterial contamination emphasizes the danger of closing extensive wounds, particularly compound fractures, unless careful and skillful débridement is possible. Even with apparently careful and time consuming débridement, we have seen fulminating gas gangrene develop in civil practice in wounds that were closed. Early diagnosis of such anaerobic infections depends largely upon close observation of the wounded extremity, particularly when it is in a cast.

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A SIMPLE, USEFUL ANTERIOR GASTROENTEROSTOMY

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IT has been said that there is always a tendency to make progress by exaggeration. Certainly this was true some years ago in the universal application of gastroenterostomy in the treatment of peptic ulcer, both gastric and duodenal. So enthusiastic were some surgeons that its successes were overstressed and its failures and complications underestimated.

With realization of the high percentage of patients with gastrojejunal ulcer and gastrojejunocolic fistula following gastroenterostomy, surgeons have turned from gastroenterostomy to the newer procedure, subtotal gastrectomy. They now are prone to have the same or even greater faith in its unreserved use, with the conviction that it offers better results than gastroenterostomy because of lower gastric acid figures and fewer gastrojejunal ulcers and gastrojejunocolic fistulas after operation.

In a recent paper on the management of the complicated peptic ulcer, Dr. S. F. Marshall and I agreed in general with this position. However, certain ulcers are so low in the duodenum that they either are fused with the common bile duct or located, more rarely, below the level of entrance of the common duct into the duodenum, so that removal requires severance and reimplantation of the bile duct into the duodenum at a lower level. This in itself would not be such a forbidding procedure except for the complicating problem of the adjacently entering pancreatic duct. We have handled such cases successfully by implanting the head of the pancreas into the side of the jejunum, as in partial removal of the pancreas for cancer; however, the procedure is of such magnitude that, under the circumstances, gastroenterostomy, even with its possible 15 per cent incidence of gastrojejunal ulcer, is a better procedure than partial gastrectomy.

In addition, there never has been any question about the satisfactory results of gastroenterostomy for cicatricial pyloric obstruction, since this occurs only in the presence of a healed ulcer. In such mechanical pyloric obstruction by scar tissue, the gastric acids are low; otherwise healing would not occur. The stomach is dilated and easily handled, and the symptoms are only those of obstruction to the passage of food past the cicatricially stenosed pylorus.

Further, in addition, an occasional patient with a duodenal ulcer that is intractable to medical management is unsuitable for subtotal gastrectomy because of an associated condition, such as hypertension, a poorly compensated cardiac lesion, an asthmatic state, bronchiectasis, or even obesity.

In the treatment of over 7,000 ulcer patients in the clinic under hospital management, we have encountered practically every possible ulcer problem, both surgical and nonsurgical. As a result of this experience, we are convinced that, even accepting the minimum of 15 per cent of postgastroenterostomy stomal ulcer, gastroenterostomy is sometimes preferable in those cases to the more hazardous subtotal gastrectomy. The reasonable efficacy of gastroenterostomy in relieving patients of ulcer symptoms is indisputable, but the wisdom of the procedure is questionable because of the frequent occurrence of a postoperative stomal ulcer that is intractable to medical management and technically difficult to handle surgically.

With these facts in mind concerning this particular group of bad risk ulcer patients, I have for many years willingly accepted for them a less desirable operation with a lower mortality rate because I prefer a live patient, even if he develops a stomal ulcer, to a patient with an acceptedly better operation who, because of the high mortality rate, is less likely to have a stomal ulcer. It is not my purpose to be facetious about such a serious subject as a fatality but rather to emphasize the necessity of balancing desirability against mortality rate in an operative procedure.

From the Department of Surgery, Lahey Clinic, Boston.

Having established this position, I wish to segregate the factors involved in this problem and to weigh them individually and collectively. First, gastroenterostomy would be a good operation were it not for the stomal ulcers. Second, gastrojejunal ulcer and gastrojejunocolic fistula are of much higher incidence than formerly was assumed. Third, these recurrent stomal ulcers are difficult to handle surgically and consequently have a relatively high mortality rate.

An analysis of these facts, which almost every surgeon would accept, simplifies the problem and facilitates recognition of important points in it. Let us put the incidence of stomach ulcer following gastroenterostomy well above that already established, say 30 per cent. That leaves 70 per cent of patients with fairly good results, which is far from undesirable provided gastroenterostomy can be made safer, provided subtotal gastrectomy can be avoided in patients with ulcers located low or fused with the bile duct, provided many conditions that often make gastroenterostomy technically difficult can be eliminated, and provided a secondary subtotal gastrectomy can be made easier should a stomal ulcer occur. It is important to mention that we commonly employ subtotal gastrectomy for patients with peptic ulcer, and that the type of gastroenterostomy herein discussed is limited to those patients in whom, because of complicating features, subtotal gastrectomy appears unduly hazardous.

Since I am constitutionally a nonconformist and am unimpressed with the sanctity of ideas, I always was skeptical about the desirability of the so called no loop posterior gastroenterostomy. This particular method, which is one of the factors which makes secondary subtotal gastrectomy for stomal ulcer difficult and serious, originally was designed to overcome the alarming so called vicious circle vomiting which sometimes followed certain gastroenterostomies. Most of these complications were related not so much to the way the loop was put on (what multitudes of pages have been written about how to place stomas!) but rather to the fact that with long loops, twisted applications and obstructive adhesions were possible. The real contributions in the principle of the no loop gastroenterostomy are that the proximal jejunal loop is so short that it is almost impossible for the surgeon to get it onto the stomach wrong, if he can get it on at all, and that obstruction seldom occurs. No loop posterior gastroenterostomy is a difficult way to do an easy operation, and if a postoperative stomal ulcer develops, subtotal gastrectomy is unnecessarily difficult and dangerous.

What surgeon with a large experience with gastric surgery has not had difficulty in doing a posterior gastroenterostomy in a patient with a short, fat mesocolon! What surgeon has not had most annoying difficulties in pulling through the opening in the root of the transverse colon mesentery an adequate amount of high, nondeliverable stomach in order to do a gastroenterostomy of adequate size without clamps, much less get a stoma of sufficient size with gastroenterostomy clamps! What surgeon has not been dissatisfied with the size of the stoma, the safety of the suture line, and the accuracy of the application of the loop and stoma in completing a no loop posterior gastroenterostomy in a fat patient, a poor anesthetic subject, with a fat filled mesentery and a high, small, nondeliverable stomach!

The most objectionable feature of a no loop posterior gastroenterostomy, in my opinion, is that an anastomosis which will not leak and will control bleeding has to be done high up in the jejunal fossa behind the colon where anatomic relations, with the stomach held up, are reversed and where good exposure is often difficult if not impossible.

These features make recurrent stomal ulcer difficult to manage by subtotal gastrectomy following no loop posterior gastroenterostomy. When a gastrojejunal ulcer does occur under such conditions, the induration about the ulcer often involves the root of the mesentery of the transverse colon and even at times includes the middle colic artery. The induration often involves the jejunal stump and makes safe resection of the short proximal jejunum difficult. In addition, if complete resection of that portion of the jejunum which forms the gastrojejunal stoma is necessary rather than partial removal of the bowel wall, the proximal intraperitoneal jejunal stump is often so short that

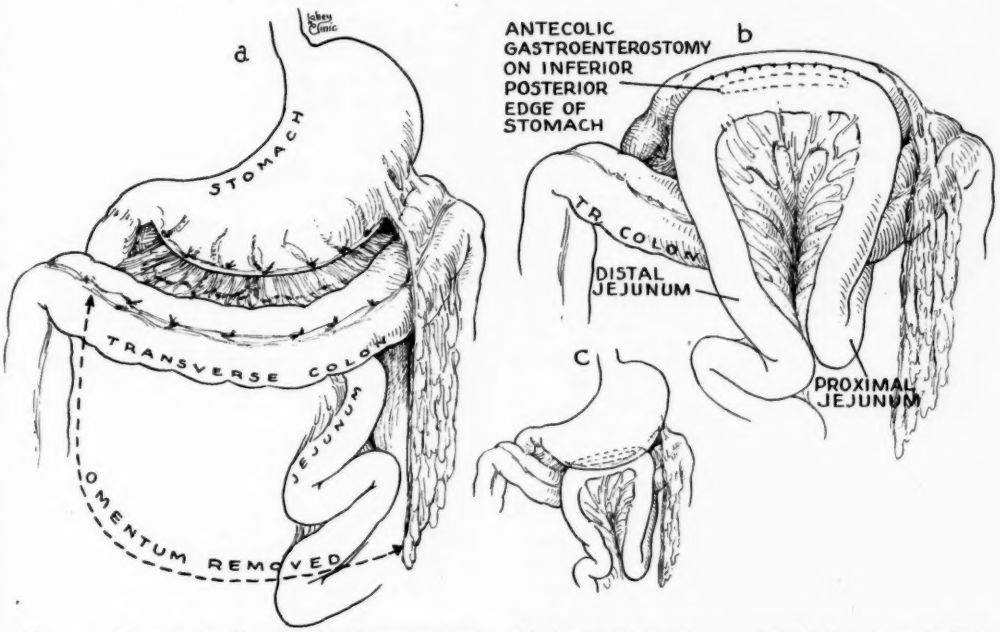

Fig. 1. *a*, The omentum is removed well over onto the left side of the greater curvature. The greater curvature is completely free and is easily lifted up. *b*, The greater curvature of the stomach is held up in a Babcock clamp (not shown), and the jejunum is attached to it just behind the greater curvature edge. In this position the gastric contents gravitate back into the stomach, and the edge of the stomach freed of its omental attachments can be lifted well up into vision and the anastomosis can be done without clamps or tension. With this mobilization there is no limitation as to the size of the stoma. *c*, The stomach is in position and the stoma is completed. Note the absence of any jejunojejunal anastomosis between the efferent and afferent loop in this procedure.

a lateral jejunal anastomosis is impossible and an end-to-end one difficult. In such high anastomoses the jejunal anastomosis can also slip under the vascular mesenteric root and become obstructed. The surgeon should also keep in mind that because the jejunum as it approaches the ligament of Treitz has such a short and meager mesentery, any interference with it easily results in loss of blood supply to the jejunal stump and a black bowel which will require still higher resection. Such complications as this prompted me to devise the retrocolic mobilization of the high jejunum to the left of the vascular mesenteric root (1).

ANTERIOR GASTROENTEROSTOMY

Because of these objections, I often have performed an anterior rather than a posterior gastroenterostomy. However, not until I had evolved the procedure herein described was I satisfied with the ease and safety with which it can be performed even in those patients with a high, nondeliverable stomach and a fat filled mesentery, and the way in which it functions postoperatively.

In spite of statements to the contrary in this country and abroad, it was my conviction that an antecolic Hofmeister or Pólya operation would function as satisfactorily as a posterior anastomosis of the jejunum to the resected stomach. It was my conviction that there would be fewer postoperative obstructions and failures to drain with antecolic anastomosis of the jejunum to the resected stomach than with posterior anastomosis. It was my further conviction that when an antecolic anastomosis was made, jejunojejunostomy between the efferent and afferent loop not only was unnecessary but undesirable, since it sidetracked the alkaline jejunal content of the proximal jejunal loop into the distal loop instead of permitting it to pass into the stump

of the resected stomach to neutralize and lower gastric acidity in the remaining gastric stump.

The soundness of these convictions is demonstrated by the fact that for several years antecolic anastomosis has been employed at the Lahey Clinic both in gastric resection for ulcer and for carcinoma without jejunojejunostomy. No obstruction, failure to drain, or malfunction has occurred.

Perhaps the most severe test of antecolic anastomosis without jejunojejunostomy occurs in total gastrectomy. We have now performed total gastrectomy upon 70 patients, and in all of them the jejunum was brought up in front of the transverse colon and anastomosed to the esophagus, and in over half of them no jejunojejunostomy was done. In all patients who survived (about 75 per cent), the anastomosis has functioned satisfactorily. If such an antecolic anastomosis of the jejunum to the stump of the esophagus without enteroenterostomy will function, the surgeon need not worry about a properly performed anterior gastroenterostomy. If an ulcer occurs following subtotal gastrectomy for ulcer with an antecolic anastomosis, the ease with which the problem can be handled by a further subtotal gastrectomy as compared with the difficulties encountered when the anastomosis is retrocolic is striking.

The most important single feature of this antecolic gastroenterostomy is the removal of the omentum from the greater gastric curvature, from the right side over to the left of the midline (Fig. 1). From our experience with removal of the omentum in gastric resection for carcinoma, we know that this procedure is safe, simple, and quickly performed. It opens the lesser peritoneal cavity and completely frees the greater curvature of the stomach of any attachments, so that it can be picked up in a Babcock forceps and turned upward easily, the loop of antecolic jejunum can be attached to it just behind the edges of the greater curvature, and a wide anastomosis without tension can be made under direct vision without clamps.

As the stomach is held up by the Babcock forceps while the jejunum is applied to the greater curvature just behind its lower edge, the gastric contents remain within the stomach by gravity, and gastroenterostomy clamps are unnecessary (Fig. 1). However, I wish to repeat that the omentum should be removed well over onto the left side and high up to the left on the greater gastric curvature. The proximal loop of jejunum should be of sufficient length so that it fits easily over the transverse colon without tension. With the stomach turned up and the transverse colon freed of omentum and visualized, twisting of the loop of the jejunum in its application to the stomach is practically impossible. An enteroenterostomy is unnecessary.

SUMMARY

The following points are discussed: (1) The types of ulcer cases in which gastroenterostomy is preferable to subtotal gastrectomy; (2) the difficulties resulting from recurrent stomal ulcers after posterior gastroenterostomy, and (3) the advantages of anterior gastroenterostomy, particularly by making subtotal gastrectomy easier and safer when a postoperative stomal ulcer occurs.

A safe and simple type of anterior gastroenterostomy with removal of the omentum from the greater gastric curvature is described and illustrated.

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A CLINICAL AND BACTERIOLOGICAL STUDY OF PHEMEROL AS A SKIN ANTISEPTIC

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THE evaluation of skin antiseptics is a difficult problem in which to arrive at any forthright conclusions. These difficulties are magnified by the variations in techniques employed by different investigators, by the selection of bacterial cultures used for study, by the interference of secretion from skin glands, and by the addition of body fluids. Because of the variations in requirements for skin antiseptics, it is quite unlikely that any one agent will be found to be superior to all others in *all* categories of use. By varying the technique of investigation, almost any antiseptic can be shown to be superior to others.

This study has been arranged to parallel the techniques of surgery for the preparation of the skin. We believe this is a practical and impartial method of comparing the clinical usefulness of skin antiseptics.

It is the purpose of this paper to report clinical and bacteriological studies on an antiseptic from a new group of drugs, the detergents. This material studied is para-tertiary-octylphenyl-diethoxy-dimethyl-benzyl-ammonium chloride, marketed as phemerol. This antiseptic was studied on patients in the obstetric and gynecological wards, a modification of the technique described by Novak and Hall in 1939 being used.

METHODS

We followed the routine technique of this institution for the preparation of the abdomen for surgery. The abdomen is scrubbed with tincture of green soap and gauze, rinsed with 70 per cent alcohol, and painted with an antiseptic. In order to have a base line for comparison, we used the same preliminary cleansing in this study. One half of the abdomen was then treated with the antiseptic studied, the soap and alcohol side being used for comparison; as the study progressed, the two sides of the abdomen were painted with different antiseptics for comparison. The accompanying diagram illustrates this technique. Small culture plates[1] containing blood agar were placed on the abdomen as soon as the antiseptic was dry. They were removed at half-hour intervals and incubated at 37 degrees C for 48 hours. The number of colonies was counted and the bacteria partially identified by subculture and stained smear.

No attempt was made to study all of the commercial antiseptics which are available. We selected members of the following groups: cresol-mercurials (Novak's solution and mercresin), the halogens (iodine), organic mercurials (merthiolate), and detergents (phemerol). It is impossible to set up exact parallels of concentration in these vastly different antiseptics. We have used the stock solutions in each case as recommended by the author and manufacturer. (Novak's solution—stock: tincture of mercresin—1:1000; tincture of merthiolate—1:1000; tincture of iodine—7 per cent; aqueous phemerol—1:500; and tincture of phemerol—1:500).

We also studied the effect of increased body temperature and sweating on the bacterial action of phemerol and made observations on skin irritation, clinical morbidity, and wound healing.

RESULTS

Using this technique of clinical bacteriology, we have studied a total of 1020 plates on 102 patients and have subcultured and identified over 50,000 bacterial colonies. The clinical studies were made on 300 consecutive obstet-

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[1]Small aluminum plates, 16 sq. cm. surface—Eimer and Amen, N. Y.

TABLE I
Number of colonies per plate

Patient	Tincture of phemerol					Tincture of soap and alcohol				
	½ hr.	1 hr.	1½ hr.	2 hr.	2½ hr.	½ hr.	1 hr.	1½ hr.	2 hr.	2½ hr.
1	3	0	18	18	20	29	38	109	27	*
2	1	0	4	0	3	*	14	6	3	*
3	8	1	26	19		24	47	*	8	
4	0	0	0	3	1	3	42	0	2	3
5	0	8	9	2	3	4	8	*	2	3
6	3	17	1	12	27	5	6	34	175	21
7	3	3	12	5	8	33	12	15	35	25
8	0	10	14	47	80	4	*	*	*	79
9	3	*	15	2	2	13	143	165	170	*
10	4	5	7	18	13	6	175	101	*	*
11	0	0	1	0	4	0	40	5	2	8
12	0	1	3	1	0	1	0	5	3	125
13	2	2	1	1	0	3	7	0	94	7
14	1	4	1	2	3	3	46	44	56	48
15	1	0	0	0	6	1	0	34	72	6
16	3	8	3	11	4	5	8	49	22	6
17	1	0	0	0	1	0	4	2	5	1
18	4	2	0	0	4	2	7	10	35	0
19	0	2	1	4	2	2	45	7	17	18
20	2	0	0	0	2	16	33	10	35	12
21	2	0	5	9	3	0	3	1	12	34
22	5	0	8	4	6	12	4	7	12	71
Total colonies	46	196	129	148	192	166	682	604	784	467

*Plates contaminated

rical and 100 surgical cases. In the tables will be found the results obtained in these studies.

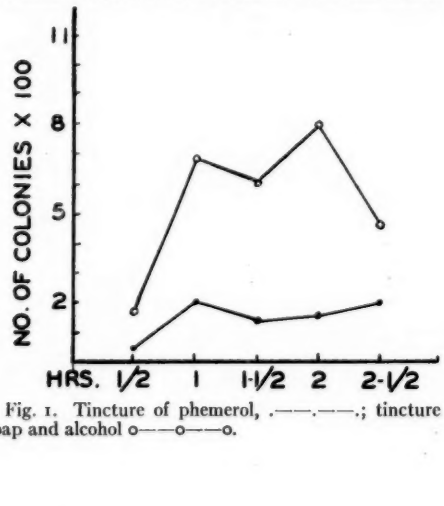

Fig. 1. Tincture of phemerol, .——.——.; tincture of soap and alcohol o——o——o.

In Table I is a comparison of tincture of green soap and alcohol and tincture of phemerol. There are approximately twice as many colonies on the soap and alcohol side of the abdomen as on the phemerol side. The bacteriostatic effect of phemerol is demonstrated in Figure 1.

Table II presents the data of a similar study in which tincture of soap and alcohol, and aqueous phemerol were used. Aqueous phemerol is a slightly more effective germicide than tincture of green soap; this is more apparent in the first hour of the study. Because of the relatively poor showing with aqueous phemerol, further studies were not made.

Table III and Figure 2 compare tincture of phemerol and Novak's solution. There are almost five times as many colonies on the Novak's solution side of the abdomen as on

TABLE II
Number of colonies per plate

Patient	Aqueous phemerol					Tincture of soap and alcohol				
	½ hr.	1 hr.	1½ hr.	2 hr.	2½ hr.	½ hr.	1 hr.	1½ hr.	2 hr.	2½ hr.
1	1	1	2	1	34	53	10	55	51	3
2	0	1	7	7	2	1	4	0	1	0
3	0	3	0	0	0	2	4	0	5	3
4	0	0	0	0	2	7	0	0	3	4
5	2	5	1	10	4	1	3	4	9	8
6	0	0	0	2	0	0	2	0	2	5
7	14	10	53	124	46	*	7	17	30	83
8	0	1	0	2	0	1	3	1	1	9
9	0	8	60	12	46	1	7	48	11	54
10	7	2	6	34	*	0	13	4	39	44
11	0	0	2	1	1	0	0	1	3	8
12	5	5	4	5	8	2	34	17	8	2
13	2	0	0	0	0	0	2	0	0	0
14	1	23	24	18	17	13	5	15	22	15
Total colonies	32	59	159	216	160	81	94	162	185	238

*Plates contaminated

the phemerol side. Phemerol was compared with another member of the same group, tincture of mercresin. In Table IV and Figure 3, are presented the data obtained from this study. Approximately six times as many bacterial colonies were found with mercresin as with phemerol.

Tincture of merthiolate, another of the mercurials, was also studied and figures obtained from this comparison are presented in Table V and Figure 4. Here it is seen that phemerol also has approximately a 6:1 advantage over merthiolate.

When phemerol and tincture of iodine are[1] compared by this technique no appreciable difference in bactericidal and bacteriostatic effect could be demonstrated. These data are presented in Table VI and Figure 5.

We further studied phemerol to determine the effect of heat and sweating on its antiseptic qualities. This investigation was carried out in a heated hospital ward during the winter; thus variation in results from patient to patient caused by differences in room temperature and humidity, as might be found during the summer season of the year, were eliminated. Both thighs of the patient were painted with the tincture of phemerol and a heat cradle was placed over *one* thigh to induce sweating. Under this technique the effect of the mixture of perspiration with phemerol on bacteria was studied; the data are tabulated in Table VII and Figure 6. Sweating does not seem to interfere with this antiseptic.

Many varieties of bacteria were found on the culture plates; of these the coccus group

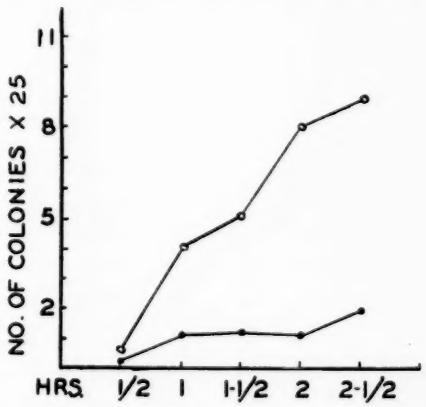

Fig. 2. Tincture of phemerol .——.——.; Novak's solution o——o——o.

[1]The iodine was allowed to dry and then washed off with 7 per cent alcohol. This was followed to parallel the usual surgical technique.

TABLE III
Number of colonies per plate

Patient	Tincture of phemerol					Novak's solution				
	½ hr.	1 hr.	1½ hr.	2 hr.	2½ hr.	½ hr.	1 hr.	1½ hr.	2 hr.	2½ hr.
1	0	5	6	6	9	2	9	18	48	36
2	1	2	7	4	10	0	5	45	15	27
3	0	0	0	1	1	1	3	0	3	3
4	1	3	3	2	1	1	48	9	13	49
5	0	3	4	2	4	1	4	3	6	9
6	0	0	0	0	1	1	4	2	2	6
7	1	1	4	0	2	1	0	2	4	0
8	0	0	0	0	0	0	1	1	1	2
9	0	9	3	0	2	0	1	13	16	15
10	1	1	0	0	0	3	2	1	3	2
11	0	0	0	0	1	1	1	2	50	2
12	1	1	0	0	1	1	0	1	1	2
13	2	1	3	1	3	1	5	3	15	5
14	1	0	0	1	0	0	5	0	1	7
15	2	0	0	7	5	1	1	4	6	6
16	1	0	0	0	3	0	0	1	1	1
17	0	1	4	1	2	4	0	4	8	12
18	1	1	0	0	0	1	1	0	1	1
19	0	0	0	1	1	3	13	23	0	20
20	2	0	1	2	2	2	6	4	5	17
Total colonies	14	28	35	28	47	19	104	136	199	232

TABLE IV
Number of colonies per plate

Patient	Tincture of phemerol					Tincture of mercresin				
	½ hr.	1 hr.	1½ hr.	2 hr.	2½ hr.	½ hr.	1 hr.	1½ hr.	2 hr.	2½ hr.
1	0	1	3	1	11	2	5	8	15	19
2	0	0	2	0	0	2	3	6	14	20
3	0	0	0	1	1	0	1	8	9	5
4	1	2	4	1	5	4	5	23	18	12
5	0	0	5	0	0	7	8	26	11	11
6	0	1	0	1	3	31	2	10	8	6
7	0	1	0	0	8	0	0	7	20	21
8	0	1	0	0	2	0	2	15	100*	20
9	0	0	1	14		6	0	20	21	
10	0	1	1	2	0	1	0	0	0	1
11	0	1	3	5	6	3	1	6	6	17
12	0	0	0	2	1	2	9	4	2	3
Total colonies	1	8	19	27	37	58	36	133	224	135

*Plates contaminated

TABLE V

Number of colonies per plate

Patient	Tincture of phemerol					Tincture of merthiolate				
	½ hr.	1 hr.	1½ hr.	2 hr.	2½ hr.	½ hr.	1 hr.	1½ hr.	2 hr.	2½ hr.
1	2	1	6	2	1	10	11	13	25	105*
2	0	0	0	1	5	0	1	1	5	4
3	0	0	0	1	0	0	2	4	5	11
4	0	0	0	4	1	0	2	2	6	5
5	0	0	0	0	0	11	4	8	13	8
6	0	0	0	2	3	2	0	6	21	9
7	0	0	1	1	2	5	4	6	2	4
8	0	1	3	2	2	15	5	3	7	7
9	1	1	1	3	4	6	10	5	14	10
Total colonies	3	3	11	16	18	49	39	48	98	163

*Plates contaminated

predominated. Streptococcus, Staphylococcus aureus and albus, and sarcina were uniformly present. While no statement can be made regarding a decrease in any specific organism, it is remarkable that only three colonies of streptococci were found on all these plates and these were on 2 patients (Case 9, Table I; Case 2, Table IV). We found less Staphylococcus aureus than albus, and the sarcina were rather infrequently present. Several bacilli were identified, chief of which were spore-formers, diphtheroids, gram-negative organisms of the colon group, and pseudomonas. An occasional mold was found. All of these organisms were quite uniformly scattered throughout the plates and did not vary significantly with the various antiseptics studied.

Concomitantly with these studies, observations were made to determine skin sensitivity or other toxic reactions which might be attributed to phemerol when employed as an antiseptic. The skin of these patients was carefully observed for several days following its application, and no evidence of irritation, desquamation, or other reactions were noted. Phemerol was used routinely on 300 consecutive obstetric deliveries and 100 surgical cases without evidence of skin irritation. This is in contrast to high incidence of skin irritation from Novak's solution (15%) which we have

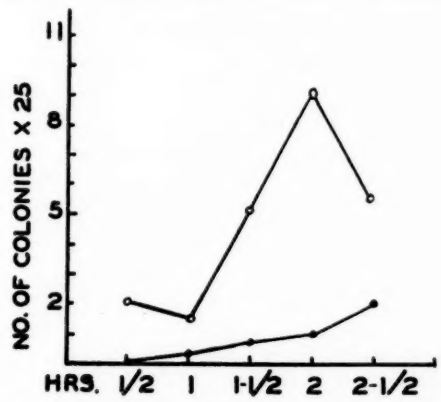

Fig. 3. Tincture of phemerol .——.——.; tincture of mercresin, o——o——o.

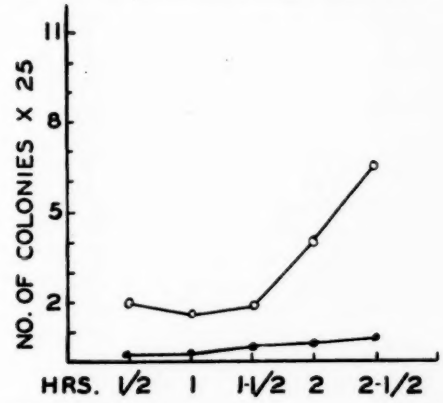

Fig. 4. Tincture of phemerol .——.——.; tincture of merthiolate o——o——o.

TABLE VI
Number of colonies per plate

Patient	Tincture of phemerol					Tincture of iodine†				
	½ hr.	1 hr.	1½ hr.	2 hr.	2½ hr.	½ hr.	1 hr.	1½ hr.	2 hr.	2½ hr.
1	1	2	10	5	3	4	4	2	8	*
2	0	1	1	0	0	1	1	9	8	3
3	0	0	2	0	0	0	2	0	0	2
4	0	2	3	10	11	0	3	0	0	1
5	3	1	3	5	1	1	1	1	1	3
6	0	1	4	1	4	1	2	0	1	2
7	0	1	3	0	0	0	0	0	1	5
8	0	0	0	1	0	0	0	0	0	4
9	0	0	0	0	0	0	0	0	2	0
10	0	1	0	1	3*	0	0	7	1	*
11	6	0	0	0	2	0	0	0	0	4
12	0	0	3	1	1	0	0	3	0	3
Total colonies	10	9	29	24	25	7	13	22	22	27

†Washed off with 70% alcohol
*Plates contaminated

TABLE VII
Number of colonies per plate

Patient	Tincture of phemerol—normal thigh					Tincture of phemerol—heated thigh				
	½ hr.	1 hr.	1½ hr.	2 hr.	2½ hr.	½ hr.	1 hr.	1½ hr.	2 hr.	2½ hr.
1	0	1	1	0	0	0	0	0	0	0
2	0	0	0	1	0	0	1	0	0	3
3	0	0	1	2	1	1	0	2	0	1
4	2	2	1	2	3	2	1	0	2	3
5	0	0	0	0	1	0	1	1	0	3
6	3	1	1	1	3	1	2	1	7	0
7	0	3	3	0	1	0	0	0	1	1
8	1	0	1	2	4	1	1	7	2	1
9	0	1	0	0	0	1	0	1	2	0
10	0	2	0	0	0	0	1	1	1	0
Total colonies	6	9	8	8	13	6	7	13	15	12

been using routinely in the delivery and operating rooms. Merthiolate and mercresin occasionally produced skin irritation; this appeared as folliculitis.

Morbidity studies are of little or no value because of the relatively minor rôle played by the antiseptic in preventing morbidity. There was no demonstrable difference in obstetrics between this group and a comparable preceding group of cases.

No interference with wound healing was observed which could be attributed to phemerol. We feel again that the antiseptic used plays a relatively minor rôle in wound healing, for skin antisepsis is only one of many factors involved.

RESULTS OF STUDY

A variety of criteria for the selection of skin antiseptics to be used in clinical surgery has been published (1–4). Many of these do not relate directly to the problems of the surgery. We believe that certain surgical principles cannot be compromised and require consideration. These antiseptics should: (1) be free of

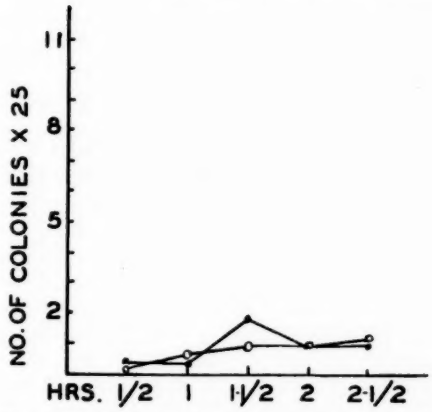

Fig. 5. Tincture of phemerol .——.——..; tincture of iodine, o——o——o.

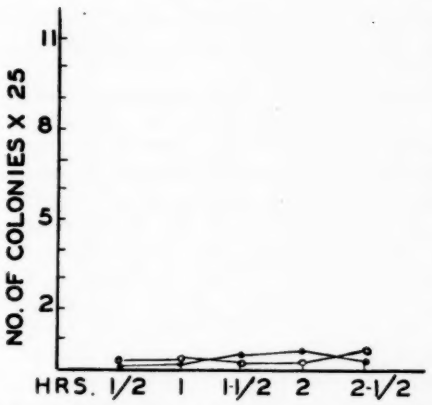

Fig. 6. Phemerol on heated thigh .——.——.; phemerol on normal thigh o——o——o.

skin irritation and toxic effects; (2) be bactericidal to pathogenic and nonpathogenic organisms found on the skin surface; (3) maintain bacteriostatic action throughout the duration of surgery; (4) not be affected by drying or contact with body fluids; (5) not interfere with wound healing. We have tried to study phemerol in relation to these criteria.

The techniques of this study are somewhat different from others reported. First, from the bacteriological standpoint, the study conditions were made to conform with the clinical procedure used in most operating rooms. The skin was first washed with tincture of soap and water and cleansed with alcohol. While this reduces the number of bacterial colonies, it does so equally on both sides of the abdomen. This preliminary cleansing is used in clinical practice and we believe this gives us a more critical base line for comparison. Second, we are comparing the two sides of the same abdomen. It is our impression that this technique permits a more accurate evaluation of skin antiseptics for clinical use than do other procedures, for it eliminates the comparison of different patients with a varying bacterial flora and degree of contamination.

From the study of the bacteria identified in this problem, it is noted that most of the bacteria usually considered pathogenic are fairly easily destroyed. Staphylococcus aureus and albus were found on plates of all the antiseptics studied, indicating that under clinical conditions as simulated in the study, these organisms are not consistently destroyed. In future studies of skin antisepsis more attention should be paid to the staphylococcus as they exist on the skin, rather than the easily killed streptococcus, pneumococcus, and bacilli of the typhoid-colon group. These latter organ-

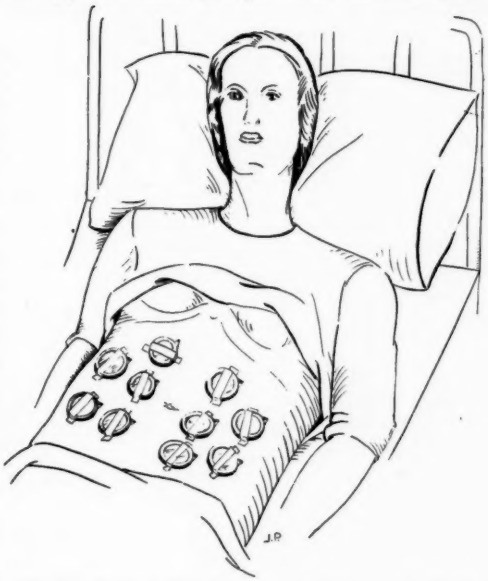

Fig. 7. Diagram of technique. The two sides of the abdomen were used for study; one side was treated with phemerol and the other side with the substance being compared. The plates were removed at one-half-hour intervals.

isms seem to be well handled by almost all of the antiseptics commonly employed at the present time.

It has been our hope to devise a technique by which we could study the penetration of antiseptics into the skin. Several unsuccessful attempts were made to precipitate antiseptic agents in the skin, thereby permitting microscopic identifications of the drug. However, the use of sweating gives us an approximate answer, for if the bacteria in the depths of the hair follicles and sweat glands were unaffected by phemerol, we would expect a rapid rise in the bacterial count as the plates were left on the heated thigh. Since this is not true (see Table VII and Fig. 6), it suggests that phemerol either penetrated the skin glands as a bacteriocide, or remained an active antiseptic when mixed with perspiration.

SUMMARY

A method of studying the various skin antiseptics commonly used in surgery has been presented. This technique employs small culture plates in direct contact with the abdomen, and uses the two sides of the abdomen for comparative data. The procedure simulates the conditions of clinical surgery, and we believe it is a practical and impartial method of comparing clinical skin antisepsis.

A total of 1020 culture plates from 102 patients, containing over 50,000 bacterial colonies, have been studied.

Members of the following groups of antiseptics have been studied: detergents, tincture of soap and alcohol, cresol-mercurials, organic mercurials, and halogens.

When tested by this technique, tincture of phemerol of the detergent group was superior to the mercurials studied, and to tincture of green soap and alcohol; it seemed about equal to tincture of iodine.

CONCLUSION

By the technique employed in this study, we find that tincture of phemerol (1:500): (a) is a good bactericidal and bacteriostatic agent, (b) does not cause skin irritation or interfere with wound healing, (c) is suitable as skin antiseptic for use in surgery and obstetrics.

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PROTEIN DEFICIENCY IN SURGICAL PATIENTS

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SURGICAL disease as such and in addition operative procedures drain the protein depots of the body and may produce hypoproteinemia. An extensive literature is devoted to this problem (8–11, 14, 20, 21, 23, 26). The significance of the hypoproteinemia depends on various factors. This study, based on experiences in 278 patients, deals with the following problems: (1) the incidence in the various surgical diseases before and after operation, (2) its influence on the final outcome of the disease, (3) its relation to red cell volume and protein concentration (which can be utilized as an index of the type and amount of parenteral fluid needed), and finally (4) the therapeutic results obtained by various protein sources.

METHOD AND MATERIAL

Venous blood was drawn (whenever possible without tourniquet) from each patient upon admission, and placed in test tubes containing dried heparin.[1] From the freshly mixed sample 1 cubic centimeter was withdrawn for the hematocrit determination (Wintrobe tube); another 0.2 cubic centimeter for hemoglobin determination with the photoclectric colorimeter. In the plasma of the remaining specimen, density was determined by the Barbour-Hamilton falling drop apparatus (5). This method is based on the fact that the specific gravity of the plasma is chiefly influenced by its protein content. When amino acids were administered, determination of the albumen and globulin fractions were done by nesslerization (16).

Repeated determinations were made on 278 surgical patients, before and after preoperative therapy, or after operation in the 193 patients who subsequently came to surgery. In many cases (Fig. 1) samples were drawn daily, or at shorter intervals if shock or hemorrhage was suspected. Usually, blood was drawn after intravenous fluid administration was discontinued for several hours except in cases in which continuous intravenous administration was required. The material examined is listed in Table I.

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[1] Liquaemin.

RESULTS

The average total plasma proteins for 278 surgical patients was 6.58 grams per cent with an incidence of hypoproteinemia of 22.3 per cent. Hypoproteinemia was common in patients with peptic (most often bleeding) ulcer, in carcinoma of the gastrointestinal tract, bowel obstruction, lesions of the biliary tract, gastrointestinal fistulas, and burns.

The average total plasma proteins following surgery of the 193 patients who were operated upon dropped 5 per cent. Of the hyperproteinemic patients 30 sustained an average drop of 11.9 per cent, 118 of the normoproteinemic patients dropped 4.6 per cent, and 42 of the hypoproteinemic ones showed an average increase of 4.3 per cent.

The only disease in which there was no loss attributable to surgery was peptic ulcer in 39 patients. An average rise of 0.3 per cent for the group is probably not significant. In view of the fact that in all cases but 2 these patients were subjected to subtotal gastric resection, this maintenance of plasma protein, in spite of the extensive surgery, appears significant and will be discussed at further length.

Of 58 cases of carcinoma of the gastrointestinal tract, 17, or 29.3 per cent, had average protein values below 6.0 grams per cent. This was seen more frequently in patients with carcinoma of the colon than in patients with carcinoma of the stomach or esophagus. In these patients protein deficits following surgery were considerably in excess of the general average of 5 per cent, being as much as 26.8 per cent in the cases of carcinoma of the colon.

In gall-bladder disease, the only significant protein changes following cholecystectomy

TABLE I.—AVERAGE PLASMA PROTEIN VALUES FOR 278 SURGICAL PATIENTS. RESULTS OF SURGERY IN 193

Disease	Total No. of cases	Average total protein gram %	No. of operatives	Average total protein of operatives gram %	Per cent change
Peptic ulcer	39	6.43	36	6.47	+ 0.3
Carcinoma—stomach	16	6.54	11	5.90	− 9.8
Carcinoma—esophagus	11	6.73	10	6.05	−11.1
Gall-bladder disease	42	6.69	26	6.51	− 2.8
Benign common duct disease	18	6.54	13	6.52	− 0.3
Carcinoma—colon	31	6.34	20	5.17	−26.8
Peritonitis	11	7.13	8	6.42	−10.0
Bowel obstruction	15	6.54	10	5.32	−18.7
Acute appendicitis	10	7.21	10	6.95	− 3.6
Thyrotoxicosis	19	6.82	13	6.31	− 7.4
Carcinoma—pancreas	4	6.49	4	6.29	− 3.0
Gynecological conditions	20	6.95	14	6.52	− 6.3
Fistulas of gastrointestinal tract	10	6.21	7	5.94	− 4.3
Burns	9	5.96			
Miscellaneous	23	6.80	13	6.30	− 7.3
Total	278	6.58	193	6.25	− 5.0

TABLE II.—INCIDENCE OF HYPOPROTEINEMIA (PROTEIN DEPLETION) IN 278 SURGICAL PATIENTS. INFLUENCE OF SURGERY ON PLASMA PROTEIN LEVEL

Diagnosis	Hyperproteinemia (above 7.5 gm. %)				Normal proteins (6.0—7.50 gm.)				Hypoproteinemia (below 6.0 gm.)			
	Preoperative		Postoperative		Preoperative		Postoperative		Preoperative		Postoperative	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Peptic ulcer	6	8.03	6	7.04	19	6.69	17	6.28	14	5.45	13	6.25
Carcinoma—stomach	2	8.12	1	5.89	7	7.03	5	6.02	7	5.63	5	5.80
Carcinoma—esophagus	3	8.09	2	7.43	7	6.33	7	5.76	1	5.42	1	5.35
Gall-bladder disease	7	7.74	6	6.64	31	6.68	20	6.48	4	5.77	0	
Common duct lesions	3	7.74	2	7.33	10	6.78	8	6.45	5	5.56	3	6.24
Carcinoma—colon	0		0		22	6.68	12	6.13	9	5.55	8	5.12
Peritonitis	4	7.65	3	6.49	7	6.75	5	6.39	0		0	
Bowel obstruction	2	8.13	1	6.43	7	6.92	5	5.21	6	5.58	4	5.20
Acute appendicitis	3	8.39	3	7.96	6	6.84	6	6.63	1	5.95	1	6.02
Thyrotoxicosis	2	7.57	2	6.92	16	6.76	10	6.27	1	5.95	1	5.58
Carcinoma—pancreas	0		0		3	6.86	3	6.34	1	5.40	1	6.16
Gynecological conditions	2	8.62	2	7.63	17	6.84	11	6.43	1	5.95	1	5.25
Fistulas of gastrointestinal tract	1	7.72	1	6.32	4	7.05	2	5.91	5	5.25	4	5.88
Burns	0		0		4	6.55	0		5	5.50	0	
Miscellaneous	4	8.07	1	6.86	17	6.62	10	6.25	2	5.85	0	
Total	39	7.93	30	6.98	177	6.71	118	6.40	62	5.54	42	5.78

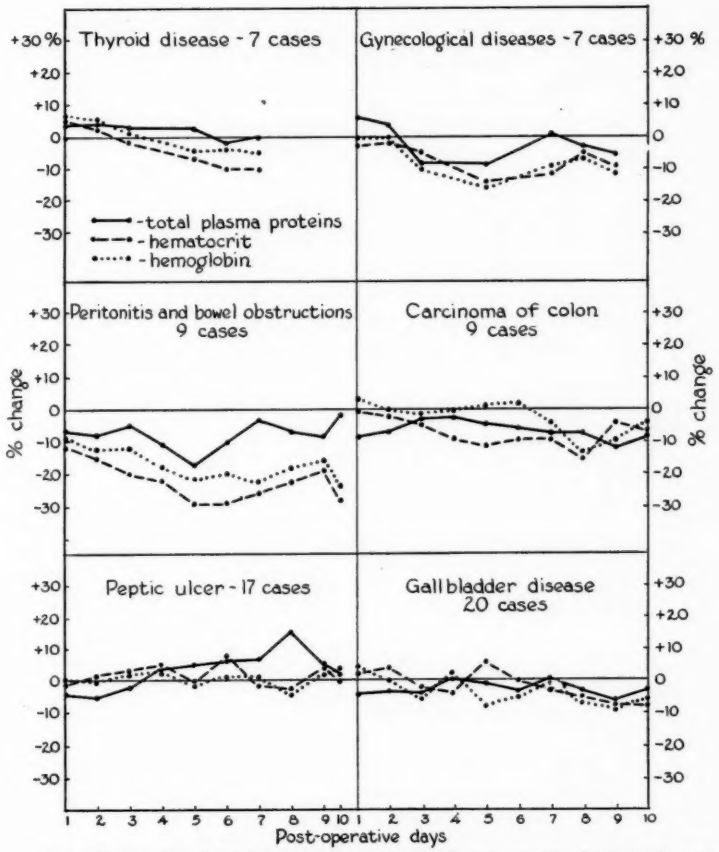

Fig. 1. Consecutive daily determinations of total plasma proteins, hematocrit, and hemoglobin in 69 surgical patients following operation. (Preoperative values were used as controls and the percentage daily change calculated therefrom as +(increase) or —(decrease). The value of these determinations in directing fluid therapy as well as anticipating shock and hemorrhage has proved itself. Note the relatively slight changes following thyroid and gall-bladder surgery, the marked changes after surgery in cases of peritonitis and bowel obstruction, the prolonged changes in surgery of carcinoma of the colon, and the improvement following gastric resection for peptic ulcer. In the case of generalized peritonitis it would appear that greater amounts of plasma or blood than was used would have been of advantage, and that more whole blood following gynecological procedures appears to be indicated. The improvement in the cases of peptic ulcer is attributed chiefly to the large amounts of blood, plasma, and amino acids that were employed.

were seen in 6 of the 26 patients operated upon who before operation were in the hyperproteinemia range; they sustained an average 14.2 per cent drop. In only 4 was preoperative hypoproteinemia present. Our experience with benign common duct lesions was essentially the same as with gall-bladder disease.

Eight of 11 patients with generalized peritonitis showed a protein decrease of 10 per cent following surgery; none of these were within the hypoproteinemia range. In 10 of 15 cases of bowel obstruction (not infrequently associated with a peritonitis) the average plasma protein loss as a result of surgery was 18.7 per cent. Six showed a preoperative

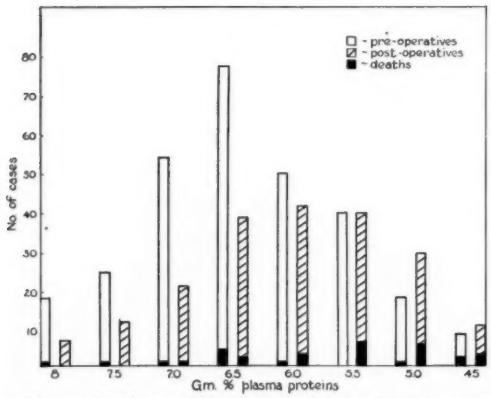

Fig. 2. Incidence of deaths according to plasma protein levels. Deaths occurred in 18 of 32 patients who either showed protein deficiencies on admission or developed them after surgery. The general trend toward a protein deficit after surgery is also shown by greater number of postoperatives on the right half of the graph than on the left half.

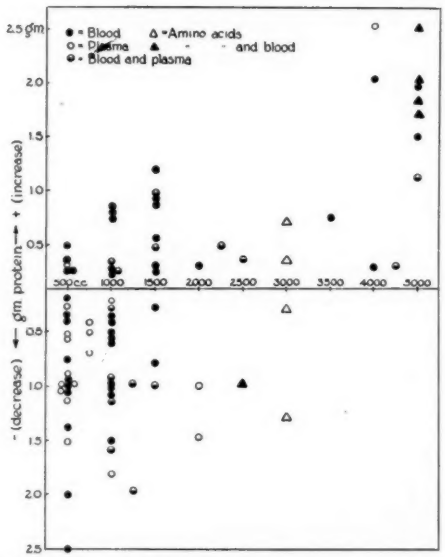

Fig. 3. The effect of the quantities and types of protein-replacement fluids on the plasma protein level. Note that the improvement was proportionate to the amounts given and that not until 2,000 cubic centimeters or more was given could consistent improvement be anticipated. Whole blood appeared to produce a greater rise in protein levels than did blood plasma; this is attributed to the value of hemoglobin as a source of protein. The striking improvement where amino acids were combined with whole blood suggests a plan of treatment whereby amino acids would be furnished for tissue proteins and a whole protein (such as blood or plasma) for the circulating proteins.

hypoproteinemia, whereas 9 showed a postoperative hypoproteinemia. Our most marked cases of hypoproteinemia have occurred in this disease.

Acute appendicitis without peritonitis failed to reveal significant changes in proteins. Of 19 patients who had a toxic goiter removed 13 showed an average decrease of 7.4 per cent; only 1 of these showed a hypoproteinemia. Of 20 gynecological patients, 14 revealed a decrease in proteins of 6.2 per cent and only 1 case of hypoproteinemia was encountered. Of 9 burn cases 5 had a hypoproteinemia on admission.

In gastrointestinal fistula (chiefly ileostomies for ulcerative colitis or permanent colostomies) the average loss of 4.3 per cent following surgery is not significant if blood or plasma administration is considered. Thus, of 5 patients with preoperative hypoproteinemia, 4 went through surgery with an average improvement of 12 per cent.

In a group of 69 patients from whom sufficient samples were drawn over a 10 day postoperative period to warrant tabulation, a correlation of the percentage changes in the plasma protein, hematocrit, and hemoglobin was attempted (Fig. 1). Preoperative values were used as controls and the per cent daily change computed therefrom.

In peptic ulcer the protein decreased slightly during the first 3 postoperative days, but thereafter improved progressively and remained above the control value. The hematocrit and hemoglobin fluctuated together remaining close to or above the control value for most of the postoperative period. The period of slight decline in proteins is to be correlated with the period of starvation which patients with gastric resection undergo, which is approximately 3 days. Further, the independent trends of the protein, hematocrit and hemoglobin changes indicate that changes in the former are not due to relative hemoconcentration.

In peritonitis and bowel obstruction the changes are marked and affected hemoglobin and hematocrit values even more than proteins. The protein decrease was greatest between the 4th and 7th days and disappeared

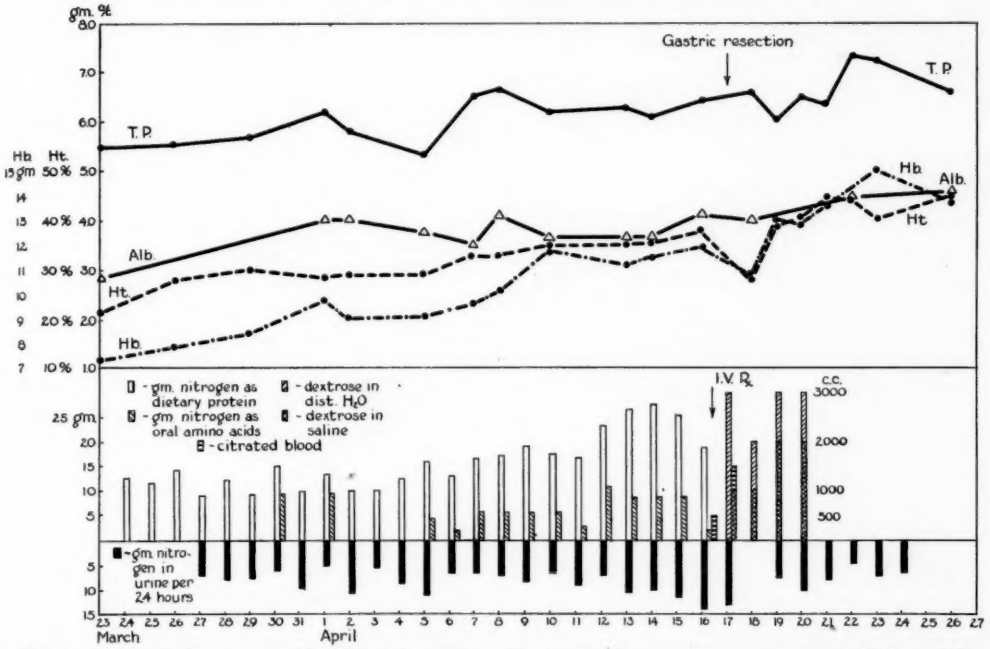

Fig. 4. Patient J. R., 50 year old white male, with a bleeding duodenal ulcer was admitted with a total plasma protein of 5.58 grams per cent, a hematocrit of 22 per cent, and a hemoglobin of 7.2 grams per cent. Nitrogen balance studies were begun and the effect of a high protein diet alone was observed for several days. This produced some improvement in the hematocrit and hemoglobin but practically none in the plasma proteins. Oral amino acids were then administered in addition to the high protein diet and from then on a consistent improvement in total protein, hematocrit and hemoglobin was seen so that just before surgery his total proteins were 6.43 grams per cent; his hematocrit, 37.5 grams per cent; and his hemoglobin, 11.9 grams per cent. An improvement in the albumen fraction of the protein was also noted and a positive nitrogen balance was assured for several days before surgery was carried out. The patient received 1,000 cubic centimeters of blood in the course of surgery and made an unusually fine recovery after operation. At the time of his discharge from the hospital his total proteins were 6.63 grams per cent; his hematocrit, 46 per cent; and his hemoglobin 13.8 grams per cent.
(T.P. = Total plasma protein; Ht. = Hematocrit; Hb. = Hemoglobin).

before the hematocrit and hemoglobin changes did. These changes seem to indicate the need for cellular elements as well as protein.

In thyroid disease there was a daily progressive decline of slight degree in all 3 factors, hematocrit and hemoglobin showing greater percentage decline than the plasma protein level.

In gynecological cases there was a roughly parallel drop in all factors, greater than anticipated.

In carcinoma of the colon the plasma proteins dropped at once and remained below control values during the entire period of observation. The hematocrit dropped more slowly but to a greater degree, and the hemoglobin most gradual of all.

In gall-bladder disease, the day to day percentage changes oscillated independently; the final result at the end of the 10 day postoperative period was a moderate decrease in all 3 factors.

Figure 2, presents a correlation of the mortality rate with the incidence of preoperative and postoperative hypoproteinemia. Of the 32 (56.2 per cent) fatal cases, 18 either had hypoproteinemia on admission or after surgery. Furthermore, 20 of the patients with preoperative and postoperative hypoproteinemia experienced one or more of the following complications: impaired wound healing, poorly functioning enterostomies, edema, anorexia, restlessness and irritability, and asthenia.

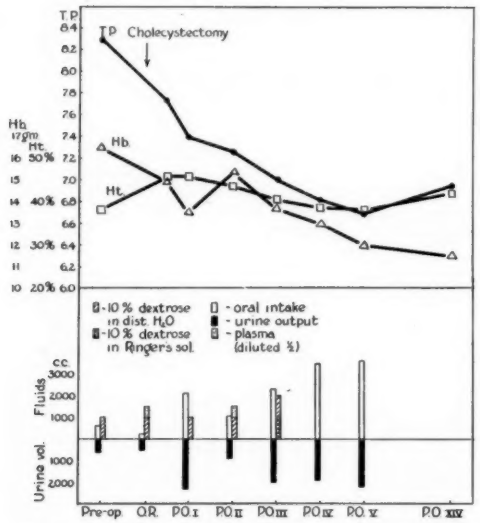

Fig. 5. Patient M. S., 44 year old white female with an acute cholecystitis. Although an apparent marked drop in protein concentration occurs, the initial level was 8.30 grams (probably due to hemoconcentration) and it was always above 6.70 grams per cent. The need for plasma protein in this case was not critical. Note the sharp contrast in the fluid balance before and after surgery.

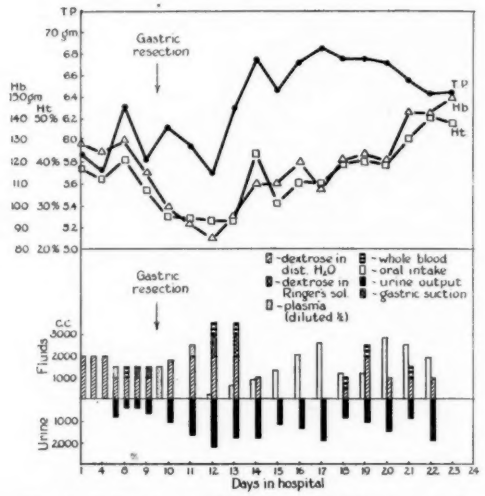

Fig. 6. T. D., 48 year old white male with a penetrating duodenal ulcer for which a subtotal gastric resection was performed. In the course of treatment he received 1,250 cubic centimeters plasma and 2,500 cubic centimeters whole citrated blood. Although a poor risk, the patient withstood surgery well. At the time of admission the patient's plasma proteins were 5.89 grams per cent, hematocrit was 38 per cent, hemoglobin 15.0 grams per cent. This improvement occurred despite the fact that the patient was a drug addict and was a feeding problem. The daily determinations of the hematocrit and hemoglobin determined the use of whole blood postoperatively in this case rather than plasma, and the results would appear to justify this decision. Note that the rise in the hematocrit and hemoglobin does not necessarily produce a rise in the total protein.

Figure 3, represents an attempt to evaluate the kinds and quantities of parenteral proteins administered to these patients. Of 24 patients who received 500 cubic centimeters of whole blood or plasma, only 5 showed an increase of plasma protein of less than 0.5 gram per cent. Three who received 750 cubic centimeters of plasma showed a decline in protein levels in the course of treatment. Of 23 patients who received 1,000 cubic centimeters of blood or plasma, or mixtures thereof, 7 showed improvement in protein levels. Of 11 patients who received 1,500 cubic centimeters of blood, or combinations of blood and plasma, 8 showed elevations in protein levels up to 1.2 grams per cent. All who received 2,000 cubic centimeters or more of blood (or combinations of it with plasma) showed improvement in protein levels during the period of observation. Two patients who received 2,000 cubic centimeters of plasma alone showed a protein decrease of more than 1.0 grams. Of 4 patients who received 3,000 cubic centimeters of amino acids intravenously alone, 2 showed a slight improvement in plasma proteins, and 2 a decrease. Four patients who received amino acids and blood totaling in all 5,000 cubic centimeters or more showed the most striking and consistent improvement in protein levels. Figure 4, illustrates the improvement in the hematocrit and hemoglobin as well as the total protein and albumin of such a patient, while he had received amino acids and dietary protein alone.

The daily determination of the total protein, hematocrit, and hemoglobin afforded information in the selection of the type of parenteral fluid best suited for the patient's needs. For example, a patient with normal or slightly elevated proteins and normal or slightly elevated hematocrit and hemoglobin may get along with dextrose and/or saline solutions. Figure 5, illustrates the condition in

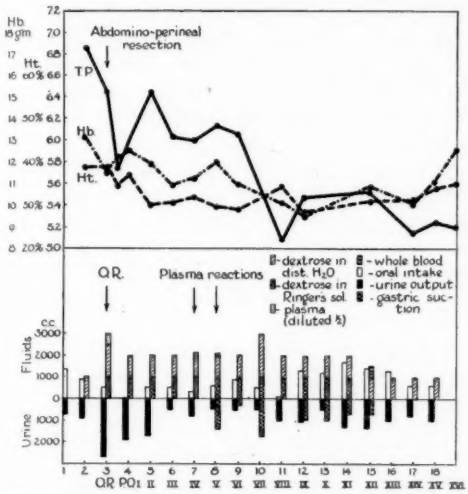

Fig. 7. M. A., 62 year old female, who developed a marked protein depletion following an abdomino perineal resection for a carcinoma of the rectum. Patient was not given more plasma or blood because of fear of reactions of which she had two (given for an associated ileus). Colostomy did not function for 2 weeks after surgery. Protein depletion followed period of 10 day starvation after surgery. Patient's proteins did not return to the lower limits of normal until 25 days after surgery. Note that the low protein levels persisted while the hematocrit and hemoglobin remained rather stable; her primary need was for plasma protein which was difficult to administer to her.

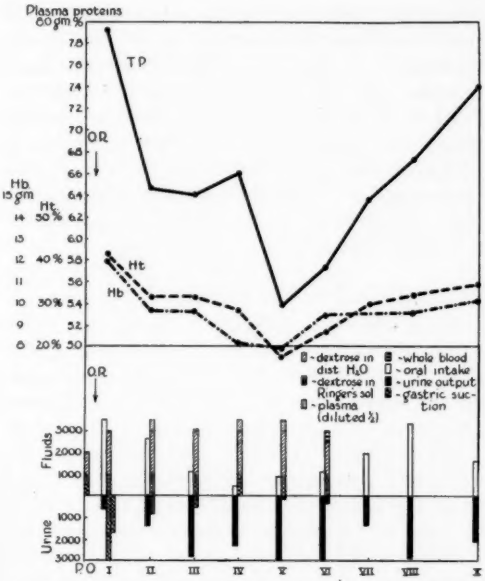

Fig. 8. E. H., 35 year old white female, with a generalized purulent peritonitis and ileus due to a gangrenous ruptured appendix which was removed. The rapidity with which a protein deficiency can occur, and its improvement as soon as the patient was able to eat is illustrated. Seven hundred and fifty cubic centimeters of plasma was without much effect in preventing this protein loss. More whole blood is indicated by the low hematocrit and hemoglobin values after plasma proteins returned to normal.

a patient who was admitted with total plasma protein of 8.30 per cent, hemoglobin of 16.4 grams, and hematocrit of 38 per cent (chronic dehydration). Her plasma protein fell considerably during her postoperative period but was always above 6.70 grams (correction of initial hemoconcentration); her protein reserves were sufficient (attested by normal values throughout her postoperative period) so that need for plasma was not critical. Her fluid balance before surgery is in sharp contrast to the intake and output after surgery was carried out.

Low preoperative total proteins, hematocrit, and hemoglobin are illustrated in a patient with a bleeding duodenal ulcer (Fig. 4) and one with a penetrating duodenal ulcer with partial obstruction of the pylorus (Fig. 6). In the former patient, a high protein diet and oral amino acids improved plasma protein, albumin, hemoglobin and hematocrit; the patient was given 1,000 cubic centimeters of whole blood in the course of a gastric resection and the factors were higher at the time of discharge than before. The positive nitrogen balance attained before surgery is shown. In the latter patient, in whom feeding difficulties were present before and after operation, 2,500 cubic centimeters of whole blood and 1,250 cubic centimeters of plasma were given; protein, hematocrit, and hemoglobin (after the immediate operative losses) increased, which justified the therapy used.

Postoperative decrease in proteins, hematocrit, and hemoglobin is illustrated in a female (Fig. 7) whose blood proteins were low from the 9th to the 25th postoperative days, following a one stage combined abdomino-perineal resection for carcinoma of the rectum. She had an ileus during the first postoperative week and the colostomy failed to function for still another week; during this period she virtually starved. Reactions to two plasma

infusions presented further difficulties. The need here was for plasma protein and it was difficult to supply it. The development of marked anemia in addition to hypoproteinemia in a patient with generalized peritonitis and bowel obstruction is shown in Figure 8; although the protein decrease was promptly improved by oral feedings, the anemia was not. Possibly more whole blood could have achieved this improvement as well.

DISCUSSION

In a discussion of the influence of disease upon the blood protein concentration, the term "protein deficiency" is to be preferred to the more commonly used term "hypoproteinemia." First, by definition, the latter concerns itself only with the circulating proteins which we now recognize as less important than the tissue protein depots. Second, there is a gradual depletion of proteins due to many causes, which although not necessarily sufficient to bring the circulating proteins within the hypoproteinemia range, are none the less important. Finally, a concept of reparation of a protein deficiency in *tissues* as well as blood will best explain our results with treatment. The importance of tissue proteins has been stressed by Madden and Whipple, Peters, and Elman (25).

At present there is no method for the determination of tissue proteins and one must depend upon indirect evidence such as the fate of protein ingested, i.e., that which does not enter the circulation nor is excreted is considered utilized in building up tissue stores. By such evidence, Sachar, Horvitz, and Elman found the ratio of tissue to circulating proteins of 30 to 1. If this is correct, any decrease of plasma proteins implies a depletion of tissue proteins many times greater.

It is desirable to learn the absolute amount of the circulating proteins (1, 13). But the dye method for the determination of plasma volume is not a routine method and cannot be repeated at will in the same patient. We attempted, however, to establish a trend by repeating daily determinations in the same patient. The time required for determining all three factors is less than an hour, requires a minimum of personnel and equipment, and may reveal significant day to day changes. We frequently withdrew blood through the same needle through which intravenous fluid was to be given; within an hour the criteria were available to determine the need for blood or plasma.

The upper limit of hypoproteinemia is not established; Binkley and associates considered 6.5 per cent, Kagan 6.0 per cent. In our own experience we found many apparently normal samples around 6.5 per cent, so that we arbitrarily selected 6.0 grams per cent as the limit.

Casten and Bodenheimer considered a fall of 0.5 gram or more in the plasma protein in surgical patients as significant; such a fall in a patient with an initial level of 5.5 grams per cent is more significant than in one with an initial level of 8.0 grams per cent. A percentage change, taking into consideration the control value, was reported by us and 10 per cent or more of them merit interpretation.

Often protein changes are attributed to hydremia. Against this is the fact that our samples were drawn several hours after intravenous fluid administration, the only slight hemodiluting effect of intravenous dextrose or saline solution or both, and the disproportionate changes in protein and hematocrit so frequently observed. Initial dehydration and hemoconcentration has, however, to be considered.

An incidence of hypoproteinemia in surgical patients of 22.3 per cent is important, especially when private and ward patients are included. This as well as other evidence (3) does not support the significance of the diet. When the hypoproteinemia which was corrected by preoperative management is counter balanced by the examples due to surgery, the postoperative incidence is approximately the same (21.8 per cent).

Protein deficiency in patients with peptic ulcer has been described (9, 18, 22). The improvement of hypoproteinemia due to peptic ulcer (chiefly due to bleeding) encountered by us is chiefly due to rather large amounts of whole blood, plasma, and amino acids used in these patients; however, the rôle of tissue proteins in correcting hemo-

dilution associated with hemorrhage must also be acknowledged.

An incidence of hypoproteinemia in patients with gastrointestinal carcinoma of 29.3 per cent exceeds the average of our series, and is in agreement with the literature (3, 21, 23, 26). Protein deficits following surgery in these patients are also more marked. According to Rhoads and his co-workers (3, 4) the protein deficiency in carcinoma of the gastrointestinal tract can be attributed to hepatic dysfunction.

Peritonitis with bowel obstruction showed in total proteins, hematocrit, and hemoglobin, on an average, very marked alterations. Five factors are responsible for these changes (2): reduced fluid intake, abnormal fluid losses, bowel distention, strangulation, and infection. Evans, in producing bowel obstruction in dogs by strangulation, could account for the actual amount of plasma lost from the circulation with fluid collected from the peritoneum and lumen of the bowel; moreover, this fluid approximated that of plasma in its protein content. Fine and associates could correlate distention of the small bowel with a fall in plasma volume which would improve with decompression.

Casten, Bodenheimer, and Barcham (9) reported a drop of more then 0.5 gram total proteins in the majority of major abdominal laparotomies and other conditions. Although the average decline in acute appendicitis, uncomplicated biliary tract disease, thyrotoxicosis, gynecological disease, and similar conditions is not marked, individual cases (Fig. 5) may show sufficient changes to warrant following total protein, hematocrit, and hemoglobin changes postoperatively. The high mortality and the incidence of nonfatal complications of hypoproteinemia stresses its significance. Moreover, the fact that hypoproteinemic ulcer patients showed improvement indicates the possibilities of appropriate preoperative and postoperative therapy. This is supported by the direct relationship between the quantities of whole blood, plasma, amino acids, and combinations thereof, and the improvement in protein levels.

The ability of whole blood to raise plasma proteins better than plasma or amino acids alone, agrees with experimental work (24). An adequate caloric intake for a surgical patient would require 26 blood transfusions of 500 cubic centimeters each per day if no protein value is attached to hemoglobin (18). Actually, whole blood or plasma in large amounts corrected the hypoproteinemia in carcinoma of the colon (6).

Amino acids given after operation to several patients with hypoproteinemia did not rise markedly the plasma protein, as reported before (6, 9, 20). Possibly these amino acids were exclusively utilized for restoring the tissue proteins. The marked improvement noted, however, when amino acids in sufficient quantity were combined with whole blood transfusions, suggests better treatment of hypoproteinemia. If amino acids are used for tissue proteins, whole blood or plasma may raise the circulating proteins.

Although several formulas exist for the estimation of the amount of plasma necessary for shock due to burns, or for blood necessary in hemorrhage, nothing aids the surgeon in determining how much blood or plasma the postoperative patient may need. We believe repeated daily observations of plasma protein, hematocrit, and hemoglobin will help in judging the amount and type of fluid to be given.

CONCLUSIONS

1. Plasma protein was determined in 278 surgical patients, the influence of surgery was followed in 193 of these. Hypoproteinemia was encountered most frequently in bleeding peptic ulcers, carcinomas of the gastrointestinal tract, bowel obstruction, and intestinal fistulas.

2. The hypoproteinemia in peptic ulcer patients was corrected by liberal amounts of blood, blood plasma, and amino acids.

3. Hypoproteinemia in carcinoma of the gastrointestinal tract, bowel obstruction, and intestinal fistulas was aggravated by surgery.

4. Hypoproteinemia improved markedly if intensive therapy was employed.

5. Of 32 fatal cases, 18 either showed a hypoproteinemia before or after surgery.

6. Incidence of plasma protein rise was related to the amount of whole blood, plasma, or amino acids, and combinations thereof

administered. Consistent improvement was seen when 2,000 cubic centimeters or more of blood alone or in combination with plasma or amino acid was given.

7. Whole blood appears to improve plasma proteins more than does plasma due to the value of hemoglobin as a protein source.

8. The combination of amino acids and whole blood as a means of treating hypoproteinemia warrants further use.

9. The daily observation of the total protein, hematocrit, and hemoglobin is suggested as an aid in deciding whether whole blood, plasma, or dextrose and/or saline solutions meets the patients' requirements best.

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RED CELL TRANSFUSIONS IN THE TREATMENT OF ANEMIA

Further Observations

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DURING the past 6 months, there has been in this country increasing interest in the use of red cell suspensions for transfusion purposes. Although relatively few articles on the subject have been published in the American literature (1, 4, 6) we have heard of such transfusions being used in a number of clinics.

In 1918, Robertson gave transfusions of red cells that had been preserved in fairly large volumes of dextrose-citrate solution. In withdrawing the supernatant fluid to the original volume of blood, most of the plasma was removed. His primary interest was in the preservation of red cells rather than in their use *per se* for the treatment of anemia. The article by Castellanos and Riera in 1937 on the practicability of using red cells for transfusion received scant attention. Beumer and Schwartzer in 1939 commented on the use of plasma free erythrocyte transfusions in children.

The large scale preparation of plasma in the present war has made available large quantities of red cells. The English have recognized the beneficial effect of transfusions of concentrated red cell suspensions in the treatment of anemia and their use has been described in detail (7, 9, 11).

The advantages of red cell suspensions over whole blood are their economy (the plasma is available for other purposes), the practicability of giving large quantities of cells over a short period of time, and the use of a smaller volume of fluid in patients with cardiac disease. The purpose of the present paper is to record further experiences with red cell transfusions in a series of patients with various types of anemia.

TECHNIQUE

The red cell suspensions used in this study were obtained through Dr. S. O. Levinson of the Samuel Deutsch Convalescent Serum Center of Michael Reese Hospital.[1] Plasma is prepared commercially at this center and the red cells had heretofore been discarded. Five hundred cubic centimeters of blood is drawn from each donor, who has previously had a Kahn test and his blood typed. The blood is drawn into a centrifuge bottle containing 50 cubic centimeters of 4 per cent sodium citrate solution and is centrifuged at 1300 revolutions per minute for 25 minutes. The plasma is then aspirated off and a sample placed on sterility test. The bottles containing the packed cells are sealed and a pilot tube containing whole blood is attached to the outside for subsequent matching with the prospective recipient. All cell suspensions are stored in the icebox at 4 to 6 degrees C. until used. The hematocrit on such suspensions was found to average from 87 to 94 per cent.

For practically all transfusions, the red cells from two donors of the same blood group were pooled and given at one time. Either type o cells or cells of the same group as the recipient were used. Before pooling, the cells from each bottle were matched against the recipient's serum. In earlier transfusions, isotonic saline solution equal to the amount of plasma that had been withdrawn was added to the cells. This was done mainly to facilitate the flow through the transfusion needle. It was later found that the addition of so much saline was unnecessary.

The technique used in most of the red cell transfusions was as follows. Six hundred cubic centimeter vacuum bottles (Baxter transfusovacs) were prepared containing 100 cubic centimeters of saline solution. The cells from two compatible donors of the same blood group were drawn into the vacuum bottle through a glass tube and a metal mesh filter, care being taken to leave behind the gel which gathers on the surface. This red cell suspension flowed freely into the recipient through an 18 or 19 gauge needle. The flow can be accelerated by raising the bottle to a higher level than usual. When smaller

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[1]Dr. Levinson gave continued co-operation and guidance during this work.

needles are used, it is well to connect a bottle of saline solution to the cell bottle with a Y tube so that the needle can be washed out with a more dilute suspension if necessary.

In the majority of cases, the packed red cells were given within 3 days from the time they were drawn; in a few cases they were given up to 5 days. No hemolysis occurred in the remaining supernatant plasma during this time. The red cell suspensions were not kept longer as it has been shown that when citrated whole blood is stored for more than 3 days, the survival time of the injected red cells decreases (2, 10). Blum claims that red cell suspensions to which dextrose has been added give satisfactory hematologic and clinical results even when kept up to 3 weeks before injection.

Although most of the cell transfusions were given to patients in the hospital, it also was found practical to give them to ambulatory patients in the out patient department. Four patients in the out patient department at the Presbyterian hospital were given 10 transfusions. The transfusions were given between 8:00 and 9:00 a.m. and if no reaction occurred by 3:00 p.m., they were allowed to return home.

RESULTS

A total of 227 red cell transfusions have been given to 100 patients with various types of anemia. One patient in the series whose case will be discussed later, received 46 of these transfusions. The causes and types of the anemia for which the transfusions were given are recorded in the table. About 80 per cent of the cell transfusions consisted of the pooled red cells from two donors each of whom gave 500 cubic centimeters of blood. This unit is referred to as a 500 cubic centimeter red cell suspension (or transfusion). It actually contains approximately 450 cubic centimeters of packed cells. Patients with mild anemia usually received a single 500 cubic centimeter red cell transfusion while in the severe cases, this amount was given on each of two consecutive days. The transfusions were then repeated as often as desired to obtain a satisfactory red cell count and hemoglobin level.

TABLE—CAUSES OR TYPES OF ANEMIA FOR WHICH RED CELL TRANSFUSIONS WERE GIVEN

	No. cases
Acute hemorrhage (including bleeding peptic ulcer)	11
Chronic hemorrhage	20
Carcinoma (with hemorrhage)	11
Postoperative anemia	11
Pernicious anemia	5
Iron deficiency anemia	3
Sepsis	19
Toxic anemia	1
Nephritis with nitrogen retention	5
Leucemia	8
Hodgkin's disease	1
Sickle cell anemia	1
Aplastic anemia	2
Cirrhosis of liver	1
Nutritional deficiency	1
	100

Red cell counts and hemoglobin determinations were made usually within 24 hours before and from 8 to 24 hours after the transfusions. In 61 patients after a single transfusion of a 500 cubic centimeter red cell suspension, the erythrocyte count increased from an average of 3.26 million to 4.14 million per cubic millimeter and the hemoglobin from 10.0 to 12.5 grams per 100 cubic centimeters. In 15 patients who received two 500 cubic centimeter cell transfusions on successive days, the erythrocyte count increased from 2.40 to 4.05 million per cubic millimeter and the hemoglobin from 6.3 grams to 11.4 grams. The increase in red count and hemoglobin value was therefore just twice as great with 1000 cubic centimeters as with a 500 cubic centimeter red cell transfusion. As might be expected, the rise in the blood values in individual cases showed rather wide variations but the increases in general compared favorably with the effects to be expected from equivalent amounts of whole blood.

No actual determinations were made of the period of survival of the transfused red cells in the recipients. As the rate of blood formation and destruction varies greatly in different types of anemia, the blood counts taken in the weeks following the transfusions were not a definite index of the survival of the injected cells. Follow-up counts in many patients after red cell transfusions showed a similar survival of the cells to what was seen in the same patients after whole blood transfusions.

All patients were observed carefully for the occurrence of reactions during or following red cell transfusions. A patient was considered to have a reaction when there was a chill or a temperature elevation of over 1.5 degrees F. Reactions occurred in 7 of the 100 patients who received multiple cell transfusions for the treatment of leucemia or aplastic anemia. All of these patients had similar reactions previously with whole blood. Of the remaining patients who received 159 cell transfusions, reactions occurred 5 times, a rate of 3.1 per cent. The average reaction rate of 100 consecutive whole blood transfusions[1]

[1]Patients who received repeated transfusions for the treatment of leucemia were omitted from this series.

given during the same period was 7.0 per cent. These results are in agreement with others who have found a lower reaction rate with red cell suspensions than with whole blood (7, 9). There were no serious effects of the reactions that occurred after cell transfusions. Jaundice was observed in 2 patients, but this was transitory and no change in kidney function could be demonstrated.

Some of the benefits observed with red cell transfusions are illustrated by the description of specific cases.

A male patient, aged 60 years, with gastrointestinal bleeding and pernicious anemia was admitted to the Henrotin hospital by ambulance for the purpose of receiving red cell transfusions. The erythrocyte count was 1.49 million per cubic millimeter, the hemoglobin 3.8 grams per 100 cubic centimeter and the blood film revealed macrocytosis and hypochromia of the red cells. In the course of 5 days, he received four red cell transfusions of 500 cubic centimeters each of which raised the erythrocyte to 3.92 millions per cubic millimeter and hemoglobin to 13.0 grams per 100 cubic centimeters. He then was discharged to his physician for further diagnostic study. Rapid correction of a severe anemia is shown in this patient.

Another patient, a male, aged 40 years had refractory bleeding from a duodenal ulcer. During the course of 16 days, he received 9 red cell transfusions of 250 to 500 cubic centimeters each, which was equivalent to 7.4 liters of blood. Bleeding stopped at the end of this time. Operation would probably have been performed in this case if sufficient blood had not been available for repeated transfusions.

A female patient, aged 34 years came to the hospital with a marked iron deficiency associated with achlorhydria and moderate menorrhagia. Her red cell count was 3.03 millions per cubic millimeter and hemoglobin 4.1 grams per 100 cubic centimeters. It was necessary for her to leave for another city in a few days. After the transfusion of 500 cubic centimeters red cells on each of two successive days, the erythrocyte count increased to 5.2 millions per cubic millimeter and the hemoglobin to 11.5 grams per 100 cubic centimeters. The rapid change from a marked pallor to a pink color to the skin and mucous membranes was a striking phenomenon. The red cells she received contained approximately 1000 milligrams metallic iron which becomes available for hemoglobin formation as the cells are destroyed.

Whole blood transfusions are of considerable temporary benefit in some patients with subacute leucemia. Besides the feeling of well-being, there is often a reduction in fever. Red cell transfusions produced such an effect in a woman, aged 36, with subacute myeloid leucemia. On several occasions after cell transfusions, her temperature which had risen to 101 degrees F. each day previously, remained below normal and she felt markedly improved. The beneficial effects began to wear off in 5 to 6 days as they did also after whole blood transfusions.

A very practical use for red cell transfusions is for the patient with refractory or aplastic anemia. Such patients are usually dependent on repeated blood transfusions as long as they live.

One such patient, a male aged 45 years, with an atypical chronic lymphatic leucemia, had an aplasia of erythropoietic tissue and had apparently completely lost the power to form red cells. The case is described in detail in previous communication (1). Over a period of 1½ years he received 46 red cell transfusions, most commonly of 500 cubic centimeters each. The total red cells given were obtained from 34.5 liters of whole blood. It was the custom to give him 500 cubic centimeters of cell suspension on each of 2 consecutive days about once a month. After the transfusions, the red cell count would increase to around 2.5 millions per cubic millimeter; after 4 weeks the count gradually decreased to 1.0 million per cubic millimeter. Assuming that this patient formed none of his own corpuscles, the injected red cells were estimated to survive for an average period of 30 days.

COMMENT

Enough evidence has been presented in the literature to establish red cell transfusions as a satisfactory substitute for whole blood in the treatment of anemia. Many patients who do not receive whole blood at the present time because of the difficulty and expense involved, would be benefited by large red cell transfusions. The anemia which results from acute hemorrhage requires 6 to 8 weeks for spontaneous recovery. With repeated 500 cubic centimeter cell transfusions, recovery of such an anemia is obtained within a few days, thus hastening convalescence greatly. Red cell transfusions would also be beneficial to patients before operation and after operation and to patients with chronic sepsis when the erythrocyte count and hemoglobin values are below the normal level.

For the present study the red cell suspensions were obtained from a center where plasma is prepared for commercial purposes. It is quite practical for such centers in metropolitan areas to make available both plasma and red cell suspensions to the various hospitals in the vicinity. By dividing the expense between the plasma and red cells, the present cost of plasma could be reduced. Also, the cost of the red cell suspensions would be much less than is now paid for whole blood from the professional donor. If red cell suspensions were made generally available at a low cost, many patients with anemia would be treated more adequately than is possible at the present time.

SUMMARY

A total of 227 red cell transfusions have been given to 100 patients with various types of anemia. One patient received 46 cell transfusions over a period of 1½ years. The erythrocyte count and hemoglobin value in these patients increased to about the same extent as with whole blood.

The percentage of reactions was lower than with whole blood transfusions. It is concluded that red cell transfusions are a satisfactory substitute for whole blood in the treatment of anemia and that they involve less difficulty and expense.

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CARCINOMA OF THE CERVIX—THE WERTHEIM OPERATION

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THIS paper represents the personal experience of the author in the radical surgical treatment of cancer of the cervix of the uterus. It is not a plea to others to undertake such surgery. Frank W. Lynch, Victor Bonney, and (the late) Fred J. Taussig have been used as guides as the work has progressed. Their enthusiasm and their well done work were inspirations. Bonney's results, so well known to all of us, were excellent but his mortality, even in his last two series of 100 cases is too great. His mortality figures had to be bettered. This might be accomplished by a better selection of cases and perhaps by the use of improved preoperative and postoperative treatment. Lynch's (2, 3) proof of the presence of apparently viable cancer cells in cervices removed after radiation and his encouragement to the author while in San Francisco spurred on this surgical experience. Taussig's (5, 6, 7) careful and thorough dissection of the pelvic lymph nodes as an adjunct to radiation of the cervix and pelvic tissues, and the apparent ability to cure, at least for 5 years, some patients with positive lymph nodes led to a desire to see his work. The observation of his dissections while in St. Louis demonstrated that part of the surgical procedure. Taussig advises pelvic lymph node dissections in all group C patients treated by radium. The results in our clinics in 12 Taussig operations caused us to decide to try, not his operation, but a radical surgical procedure, in which a combined radical surgical removal of the uterus was attempted, and in addition his method of lymph node dissection was carried out.

It has been obvious to the author, after the observation of possibly 2,000 cases of cancer of the cervix, that radiation is not the ideal method of treatment. Radiation reactions are occasionally very severe and the morbidity caused by the treatment in a large group of patients is great and depressing. It is not uncommon to find that in early cases patients fail to respond to treatment when it is obvious that if the patient had been operated upon, success might have followed. The larger the experience with radiation and the longer the follow-up of cases, the more discouraged our staff has become over our results. Patients with advanced cervical cancer occasionally do exceptionally well, and yet if in such a hospital as the Pondville Hospital (Massachusetts Department of Public Health), the absolute curability figures are considered it is apparent that in only the early and favorable cases are patients cured. Of 1000 patients of all groups and grades coming to that hospital only 100, or 10 per cent, have survived 5 years. It should be mentioned here that many of the patients at Pondville had been radiated or operated upon before coming there. In the Massachusetts General Hospital, with the use of a similar form of treatment, the end-results for 395 patients who received treatment (and not including those who were not treated) show a 5 year curability of 15.9 per cent. *Yet* in a specially studied series of 70 patients at the Pondville Hospital (4) treated by the combined method of x-ray and radium, and including all the patients that were treated, 34.3 per cent survived 5 years. This is very confusing, but it is clear that certain small series of patients treated as a special group and therefore a *selected* group, will do better than a very large group as a whole. It is unfortunate to think that in special series selections of cases are made, but it does seem obvious from the figures given that that, plus the fact that the surgeon and roentgenologist are doing a piece of research work, makes a great deal of difference.

Five reasons have led to the introduction of an old and formidable operation into the treatment of cervical cancer in our clinics. These five reasons follow:

1. If the cervix has been removed there is no chance for a recurrence in it.

2. If the cervix has been removed no cervical cancer can re-grow in it as a reoccurrence.

3. Certain cancers of the cervix are radiation resistant—a fact proved at the Pondville Hospital (8), where multiple biopsies are performed at the time the x-ray and radium treatment are being carried out.

4. There will be less damage to the bowel if surgery is undertaken. Lately 46 cases of serious bowel injury have been found in our clinics.

5. From the work of both Bonney and Taussig it is obvious that patients with lymph node metastases can be cured by surgery in some instances and the author believes that it is not possible to

From the Pondville Hospital and the Vincent Memorial Hospital (the Gynecological Service of the Massachusetts General Hospital).

TABLE I.—NUMBER OF OPERATIONS—FEBRUARY, 1939 TO JULY, 1943

	Number	Deaths	Per cent
Total	53	1	1.9
Elective	47	0	0
Nonelective	6	1	16.6

cure with radiation cancer in lymph nodes deep in the pelvis.

Other reasons, such as bleeding, discharge, fistulas, radiation reactions, etc. could be cited against radiation but the five reasons here given are the real ones upon which this surgical work was predicated.

In answer to this the proponents of radiation will remark the seriousness of the surgical procedure and will call attention to the danger to the ureters and bladder. This matter will be discussed later, and it is of real consequence in a group of surgical patients.

The surgery must be limited to certain types of patients; ideally they should be thin, young, in good health, and have an early growth. One would think that patients with such qualifications would be impossible to find but the number operated upon in our series is increasing each year and we have only occasionally stepped outside the bounds of the qualifications here enumerated.

One other group has been operated upon and will be discussed separately in the statistics and results. These are the patients in whom one or two radiation attempts at cure have failed. These cases are nonelective and are "must" cases and the results would be expected to be poor and they are. Yet one of our patients in this group has lived for 2 years and 1 month.

MATERIAL (TABLE I)

The elective material consists of a total of 47 cases—27 from the Pondville Hospital (Massachusetts Department of Public Health) 14 from the Massachusetts General Hospital, and 6 from the author's private practice. In the nonelective group there were 6 cases—4 from the Pondville Hospital, and 2 from the Massachusetts General Hospital. This surgical series was begun in 1939 and has continued to date. In the first year there were 2 patients operated upon; in 1940, 8; in 1941, 8; in 1942, 19; and in 1943 (to July), 10. More patients to operate upon were found than expected.

CLASSIFICATION OF MATERIAL

The material was classified into elective and nonelective cases and the two groups are considered separately. In the elective group according to the American College of Surgeons' classification, for in such a small group the League of Nations' classification is too complicated, there were 34 Class A cases, 9 Class B cases, and 4 Class C cases. The types and grades of malignancy were as follows:—adenocarcinoma, 6; adenoacanthoma, 1; epidermoid cancer, grade I, 4; epidermoid cancer, grade II, 13; epidermoid cancer, grade III, 20; and epidermoid cancer, grade IV, 1. Cancer which could not be graded, was found in 2 cases. The ages of the patients showed that 5 were from 20 to 29, 11 from 30 to 39, 21 from 40 to 49, 9 from 50 to 59, and 1 was 68 years old. Most of the tumors were therefore early, most were rapidly growing cancers, and most were in patients who were less than 50 years of age. Complete statistical work on such a small series is of very little value and is not presented.

PREPARATION AND CARE OF THE PATIENT

The preparation of the patient for operation is very important. This consists of admitting the patient to the hospital 4 to 5 days before the operation is to be done. The blood chemistry must be brought to normal, vitamins are supplied in large amounts to arrive as far as possible at a normal level, and blood transfusions are commonly given. Two days before operation the patient is started on 1 gram of sulfadiazine every 4 hours. The blood level has been determined in the beginning and is usually found at 6 to 8 milligrams per cent. Lately the sulfadiazine has been given without determination of the level. At operation 4 grams of sulfanilamide are placed in the large pelvic defect under the new peritoneal floor. Sulfadiazine is continued by mouth as soon as the patient can take it and is continued for 7 days after operation. In the first years sulfanilamide was used and sulfapyridine followed that, but for 2 years sulfadiazine has been the chemical of choice. Knowing full well the possibilities of foreign body reactions caused by these drugs in the peritoneal cavity sulfanilamide has been very carefully placed *under* the new peritoneal floor.

In some cases of the elective group x-ray and radium treatment were given before operation. Rarely, and yet very definitely occasionally, has radiation seemed to make the operation any more difficult; 40.4 per cent of the patients had radiation treatment before operation. Some had radium alone, some but one-half the regular dosage of x-ray or radium or both, and 10 patients had the complete x-ray and radium cycle before operation. As experience is greater it is felt that either no radiation at all or one-half the usual x-ray radiation with no radium is the method of choice

TABLE II.—COMPLICATIONS

	Cases	Per cent
Ureterovaginal fistulas	5	10.6
Ureteral catheterization at operation	17	36
Ureterovaginal fistulas after catheters	2	11.7
Ureterovaginal fistulas without catheters	3	10

TABLE III.—RESULTS

	Cases
Recurrent disease (nonelective)	6
Living (2 years and 1 month)	1
Elective cases	47
Living	44
3–4 years	5
2–3 years	4
1–2 years	13
Under 1 year	22
Dead	3
2 years and 2 months	1
1 year	2

in preparation. A small amount of radiation to injure the tumor cells, and a very small amount will do so, is probably worth while. No figures are available to settle the question definitely.

THE OPERATION

The operation is commenced by preparing the vagina by cleansing with dry gauze and washing out the vagina carefully with a double strength Schiller's solution. The bladder is catheterized and a self-retaining catheter left in place because as the operation takes a considerable time it is well to have the bladder remain empty all the time. It was formerly thought necessary to catheterize the ureters but as ureteral fistulas were considered as possibly due to this maneuver it was abandoned. The catheter is stiff and the bared ureter is easily caught by gauze sponges and stretched. Also it was felt that when the ureter was gently picked up with forceps perhaps the pressure on the inside of the ureter against the catheter as well as on the outside of the ureter might have something to do with ureteral injury. Of the entire group, however, just as many fistulas have occurred in patients having no ureteral catheters used as in those with them, so no real advice can be given about this problem.

The incision is made from the symphysis to well above the umbilicus, for the dissection starts along the common iliac artery and the aortic bifurcation is usually above the umbilicus. The first step is to dissect the bladder peritoneum from the front of the uterus and to release the bladder as far down the vagina as possible, usually to the trigone. The infundibular pelvic ligaments are ligated, the catgut is left long, and a clamp is applied and brought over the edge of the wound. The round ligament is released and the catgut tie is clamped and also brought over the edge of the wound. The dissection is then carried down the common iliac artery on the right side to its bifurcation where a lymph node may be found. The external iliac vein is located and it and its artery are stripped of all fat and possible nodes. The muscular area lateral to the artery is cleaned off, thus exposing the iliohypogastric nerve. At the bifurcation of the internal and external iliac arteries the ureter is seen attached to the medial peritoneum; it is dissected free of the peritoneum down to the area where the uterine artery coming off the internal iliac artery crosses it. This deep angle of internal iliac artery, ureters, and uterine artery and vein is a difficult place to dissect, but it must be done carefully and completely because of the possibility of a ureteral node being present. The uterine artery is tied as it arises from the internal iliac and is pulled toward the uterus, thus exposing the ureter which passes under it and on into a definite groove or canal through which it goes on to the bladder. The release of the ureter is one of the most difficult parts of the operation for occasionally it is extremely adherent. It must be freed entirely or enough vagina cannot be removed, and yet to dissect it free means to use force and a certain amount of injury occurs; it is here that the author believes the ureter is injured and fistulas develop. The ureter is freed from this canal down to the entrance into the bladder; this area is not difficult to locate as the ureter flares out as it reaches the bladder. Next the obturator fossa (first demonstrated to the author by Dr. Taussig) must be cleaned out. It lies below the distal part of the external iliac vein and is easy to find. There is usually a large amount of fat in the fossa and it is an excellent place for lymph nodes to lurk. In 5 of our 8 cases with positive lymph nodes the obturator nodes were positive. The obturator nerve is easily found running like a banjo string across the fossa. In the depth of this fossa lie arteries and veins that branch from the internal iliac. The distal part of the external iliac artery is cleaned of fat and nodes. In our series, however, this area has not contained a positive node. It is often difficult to release the bladder at its lateral extensions from the cervix, and care and patience must be exercised here. There are apt to be blood vessels that are confusing and that bleed easily. The next step is the dissection of the left group of blood vessels and lymphatics, and the ureter and obturator fossa. When all of these are released and the uterus is free the dissection is carried down the sides of the rectosigmoid, releasing the peritoneum of the cul-de-sac of Douglas in its en-

tirety. The cleavage plane between the vagina and rectum is found and the rectum is dissected as far down the vagina as possible. This part of the operation is occasionally difficult and must be carried out thoroughly for it is best to remove as much as possible of the cul-de-sac. When this is done the vagina is cut across and below the growth and as much as possible is removed. Occlusion clamps across the vagina are not used. It is often noticed that, even though the operator thinks he has removed a large cuff of vagina, when the specimen is opened he is chagrined to see how little he has removed. With the uterus out and the vagina open the vagina may be sutured with a circular running stitch, not closing the vagina but around its cuff as a hemostatic stitch. At the end of the operation the blood vessels, ureters, and obturator nerves are widely exposed. The ureters look like loose telegraph wires running across the pelvis. Care is taken to see that all bleeding has ceased. Then without attempting to drain the pelvis (the vagina is open) and without supporting the vagina by any ligament, peritonealization is carried out by suturing the peritoneum of the posterior pelvic wall to the peritoneum of the raised bladder flap. Four grams of sulfanilamide are placed under the peritoneal flap and the peritoneum is closed tight. The abdominal wall is then closed in layers. It is usual during the operation to have the patient transfused as at the end of the operation a certain amount of shock can be expected. Constant bladder drainage is continued, and the patient is put to bed with the foot of the bed on low shock blocks. From then on, except for sulfadiazine by mouth, the usual postoperative care is given. The patient is allowed to be out of bed on the 14th day.

RESULTS

Of 47 selected cases in which patients were treated in the fashion described none has died, an operative mortality of 0 per cent. It was essential in this series that the mortality be low for the results with radium in the radiated cases are so good that a 10 to 20 per cent mortality would prohibit surgery. A mortality of 0 per cent, or a very low mortality, gives the operator a feeling that at least he is as well off as is the radiologist in treating this type of disease.

The most significant complications are difficulties with the urinary tract (Table II). Cystitis, dilated ureters, and hydronephroses are the rule after operation, not the exception. In most cases an intravenous pyelogram taken before discharge will show large ureters and kidney pelves, but this condition will clear up. Occasionally patients have difficulty in voiding or emptying the bladder due to injury to the sympathetic or parasympathetic nerves. In 5, or 10.6 per cent of the 47 cases, ureteral fistulas developed, which in all cases will mean ultimate nephrectomy. This is a serious complication but not a fatal one. In 1 patient with a huge tumor both ureters were injured. Of the cases with ureteral fistulas a nearly equal percentage had had a ureteral catheter placed at operation as had not. Three of the 5 patients with fistulas had had previous x-ray treatment and 1 had had a cesarean section of the low transverse cervical type 4 months before operation. This type of cesarean section should never be done if a Wertheim operation is contemplated afterward. There have been no vesicovaginal fistulas. The bladder was opened once and it was closed without any ill effect.

In 8, or 17 per cent of cases, lymph nodes were found to be positive: iliac nodes in 4, ureteral nodes in 1, and obturator nodes in 5. The examination of the removed nodes was not carried out by serial section, as was done in Dr. Taussig's, and therefore it is quite possible that certain positive areas were overlooked in other nodes. It is extremely important, however, to realize that 8 of these patients with very early lesions would have eventually died if radiation had been used. In this group with positive nodes only 1 patient has succumbed so far. It is too early to tell what the 5 year results will be in these cases with positive nodes but they certainly will be better than in a similar radiated series.

Of the 6 patients with recurrent disease or nonelective cases in whom operation was forced upon the surgeon 5 have died, and 1 died of general peritonitis after operation. This is the only death in the series and, adding the groups together, makes 1 death in 53 patients, or 1.9 per cent. It is interesting to note, and of real importance, that the patient who died was the only one of the entire series who was not prepared with a sulfonamide. General peritonitis used to be the most common cause of death from the surgery of cervical cancer but only 1 of this series of 53 cases succumbed to this infection. Of the 6 cases with recurrent disease 1 patient is still alive without disease at 2 years and 1 month and each of the others lived over a year.

Enough time has not elapsed to make the end-results (Table III) of any value but 5 are alive over 3 years; 4, over 2 years; 13, over 1 year; and the others, for varying months under 1 year. Of the elective cases 3 died of cancer. One died of cancer of the lung 2 years and 2 months after operation, and 1 died of generalized metastases

throughout the body. This patient had huge pelvic nodes at operation and all were dissected out as carefully as possible. The third patient had a huge tumor and surgery should not have been undertaken. Three patients have recurrent disease and in one of these it has been possible to obtain a positive biopsy from the vagina.

It is impossible to judge the value of preoperative x-ray treatment for the patients have not been operated upon long enough to offer any possible basis of comparison. It is the author's feeling that it does not matter whether it is used or not, but another 5 years will be necessary to prove this.

OBSERVATIONS

It is the belief of the author, though not a confirmed one, that surgery in selected cases is a better way to treat cervical cancer than is radiation.

The experience of the patients who have had both methods of treatment has always been that the surgery was much easier to tolerate than the radiation. Therefore we should not say to patients that radiation is simple; we all know better. We know how miserable the patients are after x-ray and radium. Some are sick for weeks, some for months, and some for years. Surgery is over rapidly and quickly and is certainly more comfortable for the patient than the combined radiation treatment.

It is obvious to all of us that just as we think our patients are cured, certain ones develop a recurrence after 5 years. Often the cancer comes back as recurrence in the cervix. This is eliminated by surgery for there is no cervix present.

Surgery of this extensive type can be done safely if we take advantage of all the precautions of modern surgery. The preparation of the patient, the maintenance of good diet, hygiene, the correction of blood chemistry, the use of transfusion, and especially the use of sulfonamides make for safer surgery. This series demonstrates that in the hands of one surgeon nearly 50 selected patients were put through a gruelling operative procedure without mortality. Such results will not continue, but if the mortality can be kept low surely this method is a good one.

If it were not for injury of the ureter it would probably be safe to say that this operation is better than radiation, but a ureteral injury of 10 per cent in early cervical cancer is too large. Efforts are being made to lower this percentage.

The fact that lymph nodes can be removed and that Bonney and Taussig have demonstrated that 20 per cent with positive nodes survive for 5 years gives surgery a distinct advantage over radiation. All such patients in a radiated series must die of disease. They have a one out of five chance after surgery.

It is probable that with acquired skill strong, young, thin patients with more advanced disease should be given the opportunity of surgery rather than reliance being placed entirely on radiation. If the nodes of these patients are involved in greater proportion better results will be obtained than with radiation if the mortality can be kept low.

CONCLUSIONS

1. The main reason for this paper is to demonstrate that in properly selected and properly prepared patients the Wertheim operation plus the Taussig method of dissecting the pelvic lymph nodes can be accomplished with a low mortality.
2. The number of patients with positive lymph nodes in this selected group of cases is high—17 per cent.
3. Ureteral injury is the greatest drawback to this operative procedure and its incidence must be lowered.
4. It is the belief of the author that this method of treatment of cervical cancer will give better end-results than the present methods of radiation.

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"WAR INJURIES" IN CIVIL PRACTICE

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THOSE who have spent years on the surgical wards of civilian hospitals in the South feel that the transition from civilian to military life is not as abrupt, and the change in the nature of the work is not as great, as it is for the surgeons who have practiced in the East or the North. This is borne out by an analysis of the admissions to the surgical service of the Medical College of Virginia Hospitals in Richmond, Virginia. Where, other than in the South, would a hospital be found in which 0.1 per cent of all surgical admissions were found to have a stab wound of the heart, or 1 in every 1,390 admissions to the hospital had gas gangrene or developed it during the hospital stay?

A brief review of some of these experiences when viewed in the light of current medical articles from the war zone may give a more worth-while picture of war injuries than a mere recital of material gathered from medical journals to which all have access. Three types of war injuries occurring in a civilian hospital will be discussed.

HEART WOUNDS

Thirteen years ago Dr. I. A. Bigger became professor of surgery at the Medical College of Virginia, and the first case of stab wound of the heart was recognized and operated upon by him. Since then 43 additional patients with stab or bullet wounds of this organ have been admitted. No doubt patients with wounds of the heart were admitted prior to this date, but they either passed unrecognized or a diagnosis had been made too late to permit successful operation. This type of injury is now so thoroughly understood by the house staff that the ambulance surgeon telephones the hospital that he is bringing in a heart case so that an immediate operation can be done if necessary. All but 4 of the patients in this series were operated upon by Dr. Bigger to whom I am indebted for much of the following data on heart wounds (2, 3).

In arriving at a diagnosis the physical findings in this condition are of greater value than the history. A possible exception to this is the observation of Elkin (6) that the interval of time that elapses between injury and collapse may be of value in diagnosis. Approximately 150 cubic centimeters of blood may enter the pericardial sac before signs of tamponade appear. Once the cavity is filled, a further small increase in the amount of contained blood causes the pressure to rise rapidly with resulting obstruction to the venous return and circulatory collapse. The time elapsing between injury and collapse will therefore give a rough index as to the degree of hemorrhage. The value of this observation is, of course, lessened by several variable factors, for example: the heart cavity involved, whether auricle or ventricle, and the possible escape of blood through a rent in the pericardium.

The circulatory collapse is always greater than can be explained by the obvious blood loss. The superficial veins, especially the external jugular veins, are always distended in tamponade. The head should be level with, or slightly above, the level of the heart when testing for tamponade. The pericardial dullness is not increased immediately after injury. The heart sounds are distant and muffled. The heart may be displaced to the right by hemorrhage into the left pleural cavity.

Respiratory distress and cyanosis are present in advanced tamponade as the result of circulatory collapse and venous stasis. If the blood pressure can be obtained, the pulse pressure is low. The pulse is relatively slow in view of the low blood pressure. Bigger (5) first pointed out the value of fluoroscopy in the diagnosis of cardiac tamponade. The pericardial shadow may be little, if at all, increased, but the outline is immobile. This sign appears to be pathognomonic of tamponade. It also may aid in determining the value

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of conservative treatment. Aspiration of the pericardial sac may be resorted to as a diagnostic measure, but this has not been necessary in this series.

The patient with a heart wound who does not develop tamponade as the result of free hemorrhage into the pleural cavity or externally, is a more difficult diagnostic problem. This was true in the first heart wound operated upon by the author (10). The behavior of the patient and the location of the wound suggested a divided internal mammary artery. The incision was made with this thought in mind and considerable difficulty was had in closing a rent in the right ventricle through a relatively small incision over the course of the left internal mammary artery.

There are certain signs which may be of diagnostic aid in the absence of tamponade. Massive arterial hemorrhage from the external wound should suggest the origin of the bleeding. A splashing, churning sound synchronous with the heart beat is significant. Air, if present in the pericardial sac, should be recognized by fluoroscopy.

Local anesthesia lends itself well to the repair of heart wounds. Some of these patients are already comatose from acute alcoholism or cerebral anemia, and all have varying degrees of respiratory embarrassment. A practical difficulty sometimes arises when local anesthesia is used. When the tamponade is released, they frequently become maniacal, requiring restraint. This is an awkward happening at an inopportune time and necessitates the administration of a general anesthesia. Because of this, some surgeons use general anesthesia routinely. I have used only local anesthesia with the exception of a cardiac exploration which was done in conjunction with an intra-abdominal gunshot wound. Spinal anesthesia was given for the laparotomy, and it was found that this permitted examination of the heart through a thoracic incision. Spinal anesthesia, however, should not be used for this operation.

A left or right parasternal approach should be made depending upon the part of the heart which appears to have been injured. At least two, and sometimes three, costal cartilages should be removed. Additional space may be obtained by rongeuring away adjacent sternum, or by dividing an additional cartilage and retracting the corresponding rib upward or downward.

An extrapleural approach should be made if possible. This is more time consuming and frequently is impossible if a right sternal exposure is necessary. Regardless as to the approach, a good exposure is essential before the pericardial sac is opened. Once the pericardium is opened, one's dispositions must be made rapidly for bleeding becomes excessive when the tamponade is released. The incision should be adequate to permit immediate inspection of the involved surface of the heart. An apical traction suture of Beck aids in the control of hemorrhage and manipulation of the heart. The traction suture can be steadied by the left hand while the left index finger is placed over the opening in the heart. Interrupted sutures can be taken in the myocardium beneath the finger as recommended by Elkin (7). Silk is the best suture material. Care should be taken to avoid incorporating branches of the coronary artery in the suture. If necessary, on-end mattress sutures should be placed in order to avoid this complication. The sutures should be tied only snug enough to check bleeding. The pericardium is closed loosely with interrupted catgut sutures. The lung, if collapsed, should be re-expanded and the chest wall closed without drainage after 5 to 8 grams of sulfanilamide powder have been placed in the pleural cavity. Care should be taken that excessive amounts of sulfanilamide are not placed in the pleural cavity for it is rapidly absorbed and may lead to toxic symptoms.

All of the heart wounds treated during the first few years of this series were operated upon if they showed any evidence of tamponade or of hemorrhage into the pleural cavity. It is now the feeling that in a considerable number of these cases control can be accomplished by simple aspiration of the pericardial sac.

The present routine at the Medical College of Virginia Hospitals is as follows: A patient suspected of having a heart wound is placed in moderate Trendelenburg position and given morphine and atrophine. If he is in collapse,

5 minims of adrenalin are given and venoclysis is administered slowly. A small amount of adrenalin may be added to the intravenous solution. The blood pressure is determined frequently, and the veins of the neck are inspected with the patient in the horizontal position. The heart and the lungs are examined repeatedly for significant changes. If definite tamponade or massive hemorrhage into the chest is present the patient is operated upon immediately. If the diagnosis is uncertain and the patient's general condition is not alarming, further determinations of the arterial and venous pressure are made and the outline of the pericardium is followed fluoroscopically. If the tamponade is not excessive the sac is aspirated. This frequently relieves the symptoms dramatically. If temporary relief follows aspiration, the procedure may be repeated, depending upon the general condition of the patient and the duration of the favorable response. This temporizing method should be carried out only when the patient is in relatively good condition and with all facilities at hand for immediate operation should the patient's condition deteriorate. Aspiration of the sac has been used several times by Bigger (4) as an emergency measure to lessen tamponade while the operating room was being prepared.

The use of heparin and plasma during the past few years has been of value. Heparin has been given after extensive wounds to prevent clotting within the involved chamber of the heart, and plasma has largely supplanted the other intravenous fluids during the actual operation.

The outcome following stab wounds of the heart is more favorable than following bullet wounds. The victim of a bullet wound frequently dies before aid is available, and the operative repair is more difficult. The edges of the wound are cleaner, and as a rule there is no loss of tissue in stab wounds. Bullets usually pass completely through the heart and the pericardial sac with the result that there are considerable loss of tissue and a greater possibility of hemorrhage.

Thirty-seven of the 44 cases admitted to the Medical College of Virginia Hospitals were treated surgically. Twenty-nine were operated upon and 20 recovered. Eight patients with milder symptoms were successfully treated by aspiration alone.

ABDOMINAL WOUNDS

In this discussion, I had hoped to analyze 70 cases of abdominal wounds treated in the Medical college of Virginia during the past 4 years. Difficulties of time and space proved prohibitive, but I have several definite impressions as a result of having followed these patients. The first is that the most important thing is to repair the damage as soon as the condition of the patient permits. This may sound trite, but there may be a tendency to forget that the time element in abdominal wounds is paramount. The many recent worth-while advances in the study and treatment of shock may sometimes momentarily divert the attention of the younger men especially from the treatment of the original condition. The hanging drop method is of the greatest importance in determining the degree and progress of shock, but valuable time may be lost before operation, if too much time is devoted to quantitative determination of something that is clinically measurable. It is safer to reserve this and similar tests for postoperative guidance in the average case. This statement may be questioned, but with the ready availability of plasma and blood banks, I do not think unnecessary time should be devoted to preoperative study. The time required to examine and prepare the patient, plus that devoted to the routine emergency tests, should also be utilized to give plasma and determine the type of blood needed. By the time these preliminaries are completed, the majority of patients with gunshot wounds will be in the best condition that can be obtained preoperatively, and this should be reflected in their blood pressure and general appearance. The actual transfer to the operating room will afford a further therapeutic test of their condition and, if their pressure has remained stable, the plasma should be continued and the operation begun. The occasional civilian casualty who reverts to shock after the trauma incident to this handling, is sorely wounded and should be set aside pending further study and therapy.

The choice of the anesthetic is a debatable one. Despite the objections raised by many, I feel that a carefully given spinal anesthesia has a wider field of usefulness in abdominal wounds than is generally conceded. It has the obvious disadvantage of lowering the blood pressure, but the proper dose, level, and dilution will minimize this change, and intravenous fluids will further buffer the fall. Spinal anesthesia also has the theoretical and possibly practical danger of causing greater soiling of the peritoneal cavity, but, in carefully chosen cases, I think the operative rapidity, thoroughness, and gentleness which it permits more than offsets the hazards associated with its use. If spinal cannot be used, cyclopropane, intravenous sodium pentothal, or ether or a combination of these will be necessary.

Our experience with gunshot and stab wounds of the abdomen has not been unique. Wounds of the upper abdomen are more hazardous than those of the lower quadrant. Combined thoracic and abdominal injuries are especially dangerous. Perforations of the colon have always carried a higher mortality than those of the small bowel. Evisceration does not necessarily spell disaster. The degree of immediate shock that follows a wound of the abdomen is an index of vascular rather than bowel injury. The wound of entrance and the wound of exit gives uncertain evidence, at best, as to the probable damage within. The bizarre behavior of the bullet within the abdomen is proverbial. The only rule to observe is to place a vertical incision over the area of anticipated maximum injury and to continue the search until all of the damage has been repaired. The perforations sutured should total an even number. The usual explanation for an uneven total—that one perforation represents a glancing injury—should be viewed with misgiving. If a missile penetrates the wall of the bowel it usually traverses a portion of the lumen. The most difficult perforation to find is one located along the mesenteric border. The opening is usually obscured by a hematoma between the leaves of the mesentery. These wounds require careful search and more careful closure.

Wounds of the gall bladder are best handled by cholecystectomy if the perforations are widely separated, or by conversion of two adjacent openings into one defect through which a tube may be sutured. Rents in the liver as a rule respond better to suture than packing. A strip of muscle is also useful as a hemostatic agent. Thrombin is said to aid in checking hemorrhage from the liver. Shattering injuries of the kidney and spleen require removal of the organ. Patients with perforations of the bladder into the free peritoneal cavity may have remarkably few symptoms if the urine is sterile and not too acid.

The question of retained foreign bodies has never given us much concern. If a bullet can be palpated near the surface, we remove it before the patient leaves the hospital to avoid pain and possible subsequent abscess. If it is deeply situated and not adjacent to large vessels or nerves, we disregard it, for we feel that in all probability it will not give trouble. If infection develops the abscess serves as a guide to the retained body and its removal is simplified.

By far the most difficult problem that arises in abdominal wounds is the frequent question as to whether an intra-abdominal injury is present. Probing a tract is dangerous and misleading. Free air beneath the diaphragm is diagnostic of a gastrointestinal perforation if present, but may be deceptive if absent. Peritoneoscopy has a definite field in this type of case and much may be learned from repeated determinations of the specific gravity by the hanging drop method. Muscle spasm and rebound tenderness are probably the two most significant clinical signs. Intra-abdominal hemorrhage and perforations of the bowel cannot be differentiated with certainty, and the distinction is academic, for a reasonable likelihood of either condition demands an exploratory laparotomy.

GAS GANGRENE

A study has been made of all cases of patients with gas gangrene treated at the Medical College of Virginia Hospitals during the last decade (11). Seventy-one patients with gas gangrene were treated during this period and 21 died, a mortality of 30.9 per cent. The number of cases has been constant—36 during the first 5 years, and 35 during the last 5 years.

The mortality, however, has increased; only 8 patients died during the first 5 years, whereas 14 died during the second corresponding period. This was an increase of 75 per cent, despite the employment of additional therapeutic measures during this latter period.

The treatment during this decade corresponded to that followed generally, with the exception that prophylactic perfringens antitoxin was probably given more freely here than elsewhere and sulfanilamide was used locally very early at the Medical College of Virginia Hospitals.

In 1931, 9 patients with gas gangrene of the extremities were treated, chiefly by amputation and without perfringens antitoxin; only 1 patient died, a mortality of 11 per cent.

During the next 4 years, a prophylactic dose of perfringens antitoxin was usually administered to the traumatic cases, and large doses of antitoxin were given therapeutically. Débridements were performed more frequently than amputations. Twenty-seven patients were treated, and 7 died, a mortality of 26 per cent. In fairness to this method, it should be stated that 4 of these deaths followed gas gangrene originating in the trunk. If only the cases were included in which the gas gangrene originated in an extremity, the mortality would be exactly the same as in the first year of the tabulation, namely 11 per cent.

During the past 5 years, larger prophylactic and therapeutic doses of perfringens antitoxin have been given. Roentgen therapy was utilized frequently both prophylactically and therapeutically, and during the past 2 years many of these patients received sulfanilamide locally and generally, in addition to the usual surgical measures of débridement and amputation. Despite the intensity of this treatment, the mortality has been distressingly high—35 patients were treated, with 14 deaths, a mortality of 40 per cent. Four of the 5 patients with involvement of the trunk died. Even if we omit these cases from our tabulation, the mortality from gas gangrene of the extremities was 33.3 per cent, or three times that of the corresponding infections during the first 5 year period. A careful search was made in an effort to explain this high mortality. Some of these patients had associated injuries or disease that virtually precluded their recovery, but this was also true in our earlier cases. A possible explanation, in part, is found in the age distribution in the two 5 year series. Only 2 patients were over age 60 in the first series, while 7 patients over age 60 were found in the second period. The mortality for all patients past age 60 was 77.7 per cent. A second, and more disturbing explanation may be that the introduction of chemotherapy in some instances may have beguiled the surgeon into a false sense of security, and he may have relaxed, unconsciously, in his effort to perform a thorough débridement of recent wounds.

A study has been made of the various preventive and curative measures used in the treatment of gas gangrene at the Medical College of Virginia.

Thirty-seven patients who subsequently developed gas gangrene received perfringens antitoxin prophylactically; 10 died, a mortality of 27 per cent. Thirty-four patients who had not received perfringens antitoxin prophylactically developed gas gangrene, and 12 died, a mortality of 35.5 per cent. Superficially, this would appear to indicate that gas gangrene ran a milder course and was more amenable to treatment if antitoxin was given prior to the clinical onset of the infection. Two facts argue against this interpretation. The patient who did not receive perfringens antitoxin as a prophylactic measure was usually either admitted after the onset of gas gangrene or the possibility of gas gangrene was not considered until the infection was evident, and sometimes advanced. The patient who developed unsuspected gas gangrene, as a rule, had a serious associated condition, such as diabetes, a pre-existing gangrene, or a perforation of the gastrointestinal tract.

A second method of evaluating the value of perfringens antitoxin may be found in the various numbers of units given in this series. Nineteen patients were given a prophylactic dose of perfringens antitoxin. The mortality in these cases was 26.3 per cent. On the theory that if a small prophylactic dose was beneficial, a larger dose should be more helpful, our routine was then changed and a therapeutic dose of 10,000 units, or more, was given as a prophylactic measure to 17 patients. Five

patients also died in this series, a mortality of 29.4 per cent. In other words, the mortality was slightly higher after a larger prophylactic dose than after a small one. Two patients received 30,000 units, or 15 times the recommended prophylactic dose, and both developed gas gangrene, with death in 1 case.

Unfortunately, data are not available concerning the total number of patients who received perfringens antitoxin prophylactically in terms of the number who later developed gas gangrene, but the above figures cause doubt as to the value of antitoxin as a preventive measure. Pursuing this thought further, it is difficult to see how a massive infection can be cured by antitoxin given therapeutically if a prophylactic injection of antitoxin could not prevent the infection at its inception.

Fifty-seven patients received an average of 31,500 units of perfringens antitoxin therapeutically, and 17 died, a mortality of 30.9 per cent.

Twelve patients received sulfanilamide locally as a precautionary measure, or orally as a therapeutic procedure, and 4 died, or 33.3 per cent.

Eighteen patients received roentgen therapy as a prophylactic and therapeutic measure, or both, and 6 died, again, a mortality of 33.3 per cent. Encouraging, however, is the fact that 35 patients were given roentgen therapy prophylactically who failed to develop gas gangrene.

The operative therapy fell naturally into two groups, namely: amputation of involved extremities, or débridement, with excision of infected muscle bundles. Thirty-six limbs were amputated with 6 deaths, with a mortality of 18.2 per cent. Twenty-eight débridements were undertaken, with 8 deaths, a mortality of 28.5 per cent.

To summarize, the following prophylactic and therapeutic procedures were used in the treatment of gas gangrene, with the indicated mortality: roentgen therapy prophylactic and/or therapeutic—33.3 per cent; therapeutic perfringens antitoxin, 30.9 per cent; Sulfanilamide locally and/or generally— 30.8 per cent; prophylactic perfringens antitoxin 10,000 U— 29.3 per cent; débridement, 28.5 per cent· prophylactic perfringens antitoxin 1,000–2,000 U—26.3 per cent; amputation, 18.2 per cent.

Despite this inconclusive evidence, it was necessary to formulate a uniform method for treatment of these cases, and the following outline, based on our experience and that of others was evolved:

In additon to the usual care given in all traumatic cases, every patient in whom the deep fascia has been penetrated is considered to be a potential victim of gas bacillus infection and is treated accordingly. Treatment includes a painstaking clean-up with sterile water, green soap and shaving, followed by ether, iodine, and alcohol. The operative field is draped, and a purposeful débridement is undertaken. No nonessential tissue that has been exposed by the injury is permitted to remain. It is imperative that the full extent of the wound be determined and explored. The under surface of the extremity must be inspected for additional injuries or wounds of exit. All foreign material and devitalized bone is, of necessity, sought and removed. The original instruments are discarded. Muscle removed from the wound should be cultured for gas organisms.

I cannot leave this phase of the treatment without emphasizing again the importance of the débridement. Ultimate success or failure hinges more upon this than upon any other aspect of the therapy. A copious warm normal saline irrigation is then used, care being taken that all parts of the wound are flooded with solution. After all bleeding points are ligated, 10 grams of sulfanilamide crystals are placed in the wound if the incision is to be closed. Twice this amount may be used if the incision is to be packed open. Correspondingly smaller amounts should be used in children. The decision as to whether the incision should be closed rests upon so many considerations that I shall only say that the edges cannot be approximated without tension, or if a dead space remains, the wound is left open, with an abundant gauze pack. If a fracture is present or if the wound is near a joint, the part is immobilized by an adequate plaster encasement. Fifteen hundred units of tetanus antitoxin are injected. A prophylactic or thera-

peutic dose of perfringens antitoxin may be given, if the operator has faith in this agent. If there is any impairment of the circulation to the part, a sympathetic novocain injection should be given. Henry does this routinely in all cases of potential gas gangrene.

As soon as possible, on the day of operation, a postoperative roentgenogram is taken. This checks the position of the fragments if a fracture is present, and serves as a standard for comparison when later roentgenograms are made to determine if gas is present in the tissues. A prophylactic roentgen-ray treatment, as outlined by Kelly (9), should also be given to the involved area at this time. Twelve hours later, another film is made to determine if gas has increased in the damaged area, and a second prophylactic roentgen-ray treatment should be given. A third roentgenogram, made 24 hours after the injury, will definitely determine if a gas infection is present. If this is negative, there is little likelihood that gas gangrene will occur. Six grams of sulfanilamide, or sulfadiazine, should be given daily for the first 48 or 72 hours during this probationary period. The clinical signs and symptoms meanwhile should not be neglected, and excessive pain, swelling, tachycardia, discoloration, or crepitus should point to a gas infection. The roentgenologic diagnosis, however, can and should be made before these changes are evident. If gas gangrene develops, an immediate débridement, or open amputation, should be performed, depending upon the degree of involvement and the state of the circulation distal to the infection. Roentgen therapy and the sulfonamides should be continued. The latter should be given intravenously if a satisfactory level cannot be maintained by the oral route. An erythrocyte count and hemoglobin determination should be made daily, followed by plasma or whole blood transfusions as indicated, for these patients frequently develop a rapid and severe secondary anemia. An electrocardiogram should be made before the patient leaves the hospital, for severe myocardial damage has been reported following gas infection.

In the treatment outlined an attempt has been made to combine the best elements in our own experience with such suggestions made by others as seem to offer the greatest likelihood of success. This method was instituted slightly more than 2 years ago at the Medical College of Virginia. There was been a great reduction in the incidence of gas gangrene during the past 2 years. This improvement is due in part, no doubt, to the restrictions on the use of automobiles and the lowered speed limits. I am sure, however, that the method now employed in these cases has played a part in this reduction. While it is too early to draw definite conclusions as to the ultimate worth of the method described, we feel encouraged and justified in continuing to use it.

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THE UTERINE CONTRACTIONS ASSOCIATED WITH PROLONGED LABORS

Observations of Uterine Motility made with the Lóránd Tocograph

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THE problem created by the occurrence of prolonged labor is one of the most important met with by the obstetrician. It requires him first of all to determine whether the failure of the patient to deliver in a reasonable length of time is due to disproportion or to inadequate contractility of the myometrium. And the success with which he copes with his problem depends in many instances upon how soon he makes his differential diagnosis.

Moderate degrees of disproportion can be diagnosed by physical examination, or by resorting to the use of roentgen pelvimetry. The efficiency of the uterine contractions, on the other hand, is somewhat difficult to evaluate by physical examination, but this difficulty also can be overcome to a considerable extent by recording the character of the contractions with a Lóránd tocograph (1,2). This is a simply constructed mechanical device which supplies a permanent record of uterine activity measured through the medium of the abdominal wall.

Recently we had the opportunity of studying, with the tocograph, the uterine contractions of a series of patients at frequent and regular intervals throughout labor. The majority of the patients delivered after labors of normal duration. A few, however, experienced unusually long labors. The tocographic records of the patients experiencing long labors exhibited certain characteristics which distinguished them from the records of the patients who delivered in a normal length of time. Since knowledge gained from a study of both sets of records appeared to have clinical as well as academic interest, typical records are presented and discussed in order to illustrate the points in question.

MATERIALS AND METHODS

The uterine contractions of 105 women, who were being delivered vaginally in the Hospital of the University of Pennsylvania, were registered at 1½ to 2 hour intervals throughout their labors with a Lóránd tocograph. Complete sets of tocographic observations supplied by 3 of the patients in the series, who experienced unusually long labors, form the basis for the present analysis. Other data upon the labors of the 105 patients have been reported upon previously (3, 4).

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RESULTS

Labor of normal duration. Figure 1 reproduces the tocographic record of a multipara who experienced a labor of 16 hours' duration. She delivered spontaneously an infant weighing 2,730 grams. Her tracings, which are typical of the contraction pattern observed in association with adequate uterine motility, reveal waves of normal height and length, waves which recur at regular intervals, and ones which resemble each other in both size and shape.

The motility associated with labors of good quality and of normal length is characterized by a contraction pattern of such a kind that it is possible, in one's mind's eye to superimpose any wave and its following trough upon either of its adjacent waves and their troughs. The effectiveness of the uterine motility is increased further if the waves are of greater than average magnitude.

Prolonged labor. As can be demonstrated in the accompanying graphs, a prolonged labor may be associated with either normal or abnormal uterine motility.

Prolonged labor associated with normal uterine motility. Figure 2 reveals the uterine contraction pattern of a multipara who experienced a normal uterine motility throughout her entire labor of 91 hours' duration.

The prolongation of her labor was due to disproportion which included the existence of: (a) an android pelvis, (b) pelvic funnelling with associated unusual prominence of the ischial spines, (c) a posterior position of the occiput which necessitated manual rotation and forceps extraction, and (d) an infant which weighed 4,450 grams.

The tocographic tracings of this patient reveal waves of excellent height, length, and rhythmicity, and ones which resemble each other rather closely in most characteristics.

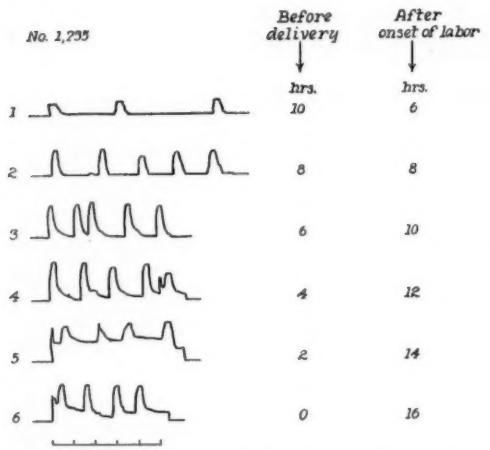

Fig. 1. Tocographic record of normal uterine contractions occurring in a labor of 16 hours' duration. Time intervals 3 minutes. Note: (a) magnitude, (b) rhythmicity and (c) uniformity in size and shape of waves.

Prolonged labor associated with primary uterine inertia. Figure 3 reproduces the contraction pattern of a primipara who delivered herself of an 1,850 gram infant at the 36th week of pregnancy. The infant presented by the breech. This patient experienced an inadequate uterine motility throughout her entire labor of 47 hours' duration.

The contraction pattern of this patient is characterized by: (a) waves of small magnitude, (b) ones which vary in size and shape, and (c) lack of a normal rhythmicity of occurrence of successive waves.

Prolonged labor associated with primary and secondary inertia. Figure 4 records the contraction pattern of a primipara who experienced both primary and secondary inertia. Her waves are smaller than those which are typical of normal labor, and they have lost their rhythmicity at times, as shown in tracings 4 and 5. From tracing 9 onward there is almost a total absence of any intermittent contraction waves, indicating the existence of a secondary inertia.

EVALUATION OF STUDY

The present observations demonstrate the feasibility of acquiring consistently uniform records of uterine motility with the tocograph at intervals through labor. They indicate, furthermore, that the pattern of contraction is established early and persists throughout labor, and that each patient exhibits a pattern which is peculiar to herself.

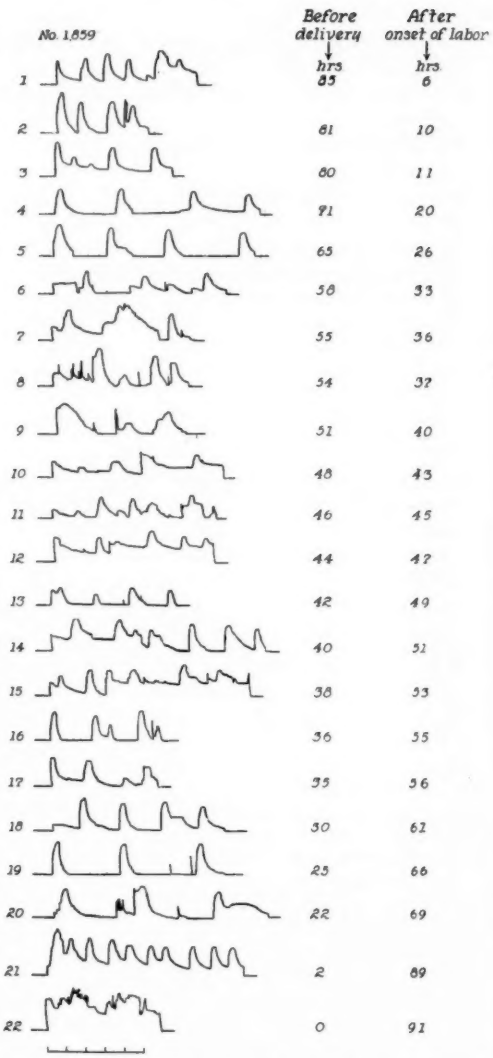

Fig. 2. Tocographic record of normal uterine contractions observed during a labor of 91 hours' duration. Time intervals, 3 minutes. Delay in delivery due to disproportion. Note persistence of (a) large waves, (b) average rhythmicity, and (c) satisfactory uniformity in size and shape of waves throughout the whole labor period.

At the beginning of labor, the patient will reveal either a good or a poor type of motility, and it is usually the case for the original quality of uterine activity, to be maintained throughout the labor.

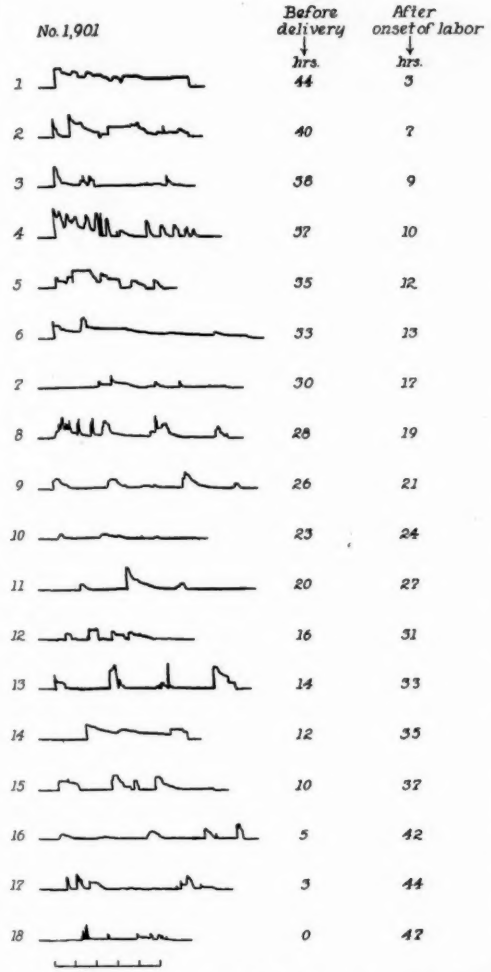

Fig. 3. Tocographic record of abnormal uterine contractions (primary inertia) throughout a labor of 47 hours' duration. Time intervals 3 minutes. No evidence of disproportion. Note: (a) small size of waves, (b) absence of satisfactory rhythmicity and (c) wide variation in the size and shape of successive waves.

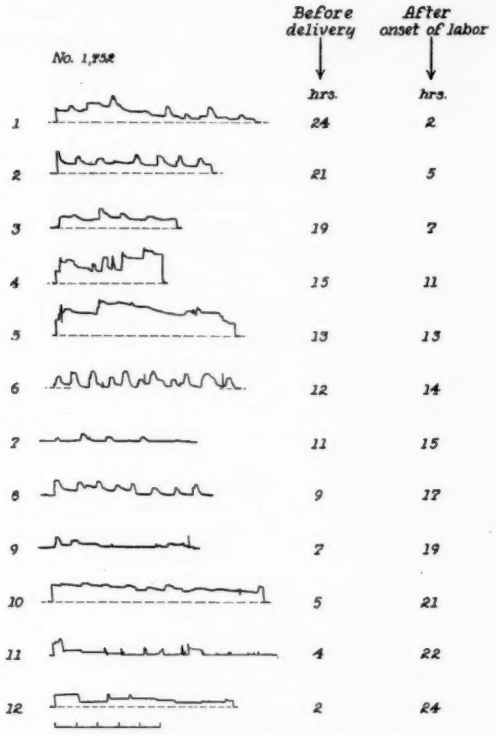

Fig. 4. Tocographic record of abnormal uterine contractions during a labor of 24 hours' duration. Time intervals 3 minutes. Note: (a) small size of waves where present, (b) absence of rhythmicity (tracings 4 and 5), both of which are signs of primary inertia, (c) absence of waves beginning with tracing 9, indicating existence of secondary inertia.

If a satisfactory pattern of contraction becomes established early, a labor of normal duration should be expected in the absence of any evidence of disproportion. If labor is prolonged, with a normal pattern of motility, any delay in delivery is probably due to an undetected disproportion.

If the tocographic record gives evidence of primary inertia early in labor, one of two sequels is to be expected. Either the primary inertia will continue, or the uterine contractions will cease altogether, the primary becoming a secondary inertia. As yet, the writer has not observed a secondary inertia to follow an earlier normal motility in the absence of disproportion.

From such observations as these, it must be apparent that tocographic recordings made systematically throughout labor can aid greatly in understanding the character of the uterine activity during labor. And an important feature of this aid is that it is acquired early in labor. By virtue of this last fact, the obstetrician is placed in a position where he can distinguish relatively early in labor whether he is dealing with inertia or disproportion. If he finds that he has a case of primary inertia on his hands, by securing tocographic records at intervals, he will then be able

to discover whether the patient ultimately develops a secondary inertia and just when that occurs. With this information available, he will then be in a position to terminate the labor without undue delay.

SUMMARY AND CONCLUSIONS

1. The uterine contractions of 105 patients were registered at 1½ to 2 hour intervals throughout labor with a Lóránd tocograph.

2. The tocographic records of 3 patients who experienced prolonged labors are reproduced.

3. The uniformity in the character of the tracings of a given individual demonstrates the feasibility of recording the uterine contractions at frequent intervals throughout labor.

4. The character of the contraction pattern is established early in labor, and with minor modifications persists throughout labor.

5. The contraction pattern of one individual differs significantly from that of another.

6. A prolonged labor may be associated with either a normal or an abnormal uterine contraction pattern.

7. The persistence of a normal contraction pattern throughout a prolonged labor suggests that any delay in delivery is due to disproportion, rather than to inertia.

8. The contraction pattern characteristic of primary uterine inertia is established early in the course of labor.

9. The tocograph will record not only the existence of a primary inertia, but also indicate its degree. Furthermore, regular tocographic tracings will record the first appearance of secondary inertia.

10. From these observations it is concluded that systematic recording of the character of the uterine motility during labor by means of the Lóránd tocograph can aid the obstetrician in the conduct of the labor.

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CONSERVATIVE TREATMENT OF ACUTE INVERSION OF THE UTERUS

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ACUTE puerperal inversion of the uterus is a comparatively rare lesion with a reported incidence varying from 1 in 740 to 1 in 16,000 (3) deliveries. One can assume, therefore, that the average obstetrician will encounter this serious complication one or more times during his career. Because the author had the opportunity to see 4 acute puerperal inversions of the uterus within a period of 6 months, he feels justified in reporting them.

CASE 1. Mrs. D. S., a primipara, aged 28 years, was delivered spontaneously under chloroform anesthesia of a 7 pound 9 ounce, normal female, after 8 hours of labor. The placenta was delivered 12 minutes later assisted by Credé's method. Repair of a first degree laceration of the cervix followed. When the patient began to bleed, 1 cubic centimeter of ergotrate was given, and the vagina was packed in an attempt to control hemorrhage. Intravenous therapy was started; 1000 cubic centimeters of 5 per cent glucose and 1500 cubic centimeters of whole blood had been given over a period of 8 hours, and 3 cubic centimeters of ergotrate when the patient was first seen by the author and the inversion of the uterus was discovered. The patient's blood pressure was now 60/20, and she was in deep shock. The temptation to correct the inversion of the uterus was resisted, and only a firm packing of the vagina around the fundus was done at this time. Stimulants, intravenous fluids, and whole blood were continued, and the patient slowly recovered from shock. Six days later under combined spinal and inhalation (cyclopropane) anesthesia, the inversion was reduced by taxis. The fundus was not packed. Another pint of blood was then given. Four days later the patient voided spontaneously for the first time since her delivery, and the headaches complained of after surgery now disappeared. On the whole, her postoperative course was smooth, with the temperature rising only once to 100.2 degrees on the first postoperative day. A postpartum examination made 6 weeks after her release from the hospital showed the uterus to be normal in every respect, although there was a slight erosion of the cervix which was subsequently cauterized. Six months postpartum the pelvis was found to be normal in every way.

CASE 2. Mrs. E. S. a tripara, aged 20 years, was delivered under chloroform anesthesia of a normal male infant weighing 7 pounds and 15 ounces, after 3 hours of labor. One cubic centimeter of pituitrin was given, and 5 minutes later, by modified Credé-method, the placenta was delivered still attached to the uterus which was found to be completely inverted. The patient immediately went into deep shock and began to bleed. The placenta was separated from the uterus, the uterus was restored to the vagina, and the vagina was firmly packed. Intravenous therapy was promptly started and 500 cubic centimeters of plasma, 1000 cubic centimeters of 5 per cent glucose, and 2000 cubic centimeters of blood were given over a period of 6 days postpartum. On the 6th postpartum day, under combined spinal and inhalation (cyclopropane) anesthesia, the inversion was corrected by taxis, and the fundus was packed with plain sterile gauze. The temperature rose to 103 degrees on the first postoperative day to drop promptly to normal and remain so after the packing was removed 24 hours later. This patient received no ergotrate postpartum, but did receive 1 gram of sulfanilamide 3 times a day postpartum, and sulfathiazole after operation. She voided spontaneously for the first time after correction of the inversion. A postpartum examination which was made 4 weeks later showed the pelvis to be normal in every way.

CASE 3. Mrs. M. B. a secundipara was delivered under chloroform anesthesia, with outlet forceps of a normal male infant weighing 7 pounds and 6 ounces, after 3 hours of labor. A repair of a first degree perineal laceration followed. Six minutes after the delivery the placenta appeared assisted by Credé's method. One cubic centimeter of pituitrin was given. The patient began to bleed and promptly went into shock. The inversion was discovered, and the vagina was firmly packed around the uterine fundus to control the hemorrhage. The blood pressure dropped to 86/40, the patient was restless, the pulse rapid and thready. Intravenous therapy was promptly started and 500 cubic centimeters of plasma and 2000 cubic centimeters of whole blood were given over a period of 5 days. This patient was able to void on the first postpartum day. Despite 1 gram of sulfadiazine 3 times daily, this patient ran a low grade septic course, with the temperature rising to 102.2 degrees on the 3d postpartum day but averaging 100 degrees until 2 days before her dismissal from the hospital. On the 7th postpartum day the inversion of the uterus was corrected by taxis under combined spinal and inhalation (cyclopropane) anesthesia, and 8 days after surgery she was discharged from the hospital. A postpartum examination made 4 weeks later showed the pelvis to be perfectly normal in every way. Fourteen months later this patient was delivered again, on this occasion without any complications.

CASE 4. Mrs. J. S., a primipara, aged 23 years, was delivered under chloroform anesthesia, after 10 hours of labor, with outlet forceps, of a normal 7 pound female infant. Following repair of the midline episiotomy, the abdomen was palpated to ascertain whether or not the placenta had separated and the fundus could be felt. Just then the placenta appeared at the vulva and was delivered (10 minutes after the delivery) with gentle traction upon the cord. The diagnosis of complete inversion of the uterus was then confirmed. However, the patient showed no signs of shock and had not started to bleed. She was therefore, promptly reanesthetized and the inversion was corrected by taxis. She was given 1 cubic centimeter of ergotrate and was returned to her room in good condition. Her temperature rose to 101 degrees on the 3d postpartum day, to subside to normal and remain so after her 5th postpartum day. Sulfathiazole—7.7 grains, 3 times daily—was given until her dismissal from the hospital on the 11th postpartum day, when she was fully recovered. A postpartum examination made 4 weeks later showed the pelvis to be normal in every way. Sixteen months later, this patient is again pregnant and approaching term.

Although no criteria are available to lead one to anticipate acute inversion of the uterus that carries with it a mortality rate (3) of 10 to 43 per cent, much has been written about the etiology of this obstetrical complication. Mismanagement (7) of the third stage of labor particularly has been stressed, perhaps to the point which deters some from reporting such accidents. In the management of the uterine inversion authors (6) generally agree that in the absence of shock the inversion may be corrected at once, but that in the presence of shock, shock must be treated first, promptly and effectively. From this point on authors differ. Some favor conservative treatment and correct the inversion by taxis from below, a few hours, a few days, or even a few weeks later. Others favor operative treatment a few weeks or months later, either vaginally or abdominally (2, 4, 5, 9), either to correct the inversion of the uterus or to remove the uterus itself. Some authors have advocated the administration of adrenalin (1, 10); others, spinal anesthesia to assist in relaxing the constricting cervix. The author has had no experience with the former, and added just enough inhalation anesthesia to the latter to allay the patient's fears. No cases of chronic inversion of the uterus were seen, and therefore no attempt is made to discuss them. Although 4 cases constitute but a small series, nevertheless the successful termination of each, following a definite plan of management (and it is readily admitted that none of these individual steps are original), may help to establish a standard routine for the treatment of acute puerperal inversion of the uterus, as follows:

1. If the patient is not in shock, manipulative correction of the inversion of the uterus under deep anesthesia may be attempted immediately.

2. If the patient is in shock, the shock is treated first and manipulation is delayed until the patient has recovered from it.

3. Hemorrhage is to be controlled by firm packing of the vagina against the inverted fundus, and blood loss compensated with repeated transfusions of whole blood, plasma, and intravenous fluids.

4. The patient is to be catheterized if unable to void spontaneously.

5. Some form of ergot may be given to hasten involution.

6. Some one of the sulfonamides may be given prophylactically to guard against infection.

7. About 1 week postpartum, with the patient recovered from shock, the uterus partly involuted, (now approximately the size of an 8 ounce glass tumbler), under combined spinal and inhalation anesthesia, the inversion can be corrected by taxis, i.e., squeezing the fundus as one would a rubber ball held in the palm of one's hand.

8. The uterine cavity may or may not then be packed to prevent reinversion of the uterus. (The author omitted this step in 3 of the 4 cases described in this paper.)

CONCLUSIONS

1. Acute inversion of the uterus may be the result of uterine atony, pressure on the fundus above, traction on the cord from below. It may also be wholly spontaneous.

2. In the absence of shock the inversion may be corrected at once.

3. In the presence of shock all manipulative efforts are to be deferred until the patient has recovered from it.

4. Under anesthesia, preferably spinal anesthesia, the inversion is corrected by taxis.

5. This conservative treatment made it possible for 2 of these 4 patients to have another baby. Two of these patients have since been delivered again with perfectly normal labors and postpartum courses.

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RIGHT RECTUS GRIDIRON INCISION IN CONGENITAL HYPERTROPHIC PYLORIC STENOSIS

HERBERT H. DAVIS, M.D., F.A.C.S., Omaha, Nebraska

THE purpose of this report is to describe a new incision for use in the Fredet-Rammstedt type of operation for congenital hypertrophic pyloric stenosis. Previously three main types of incision were used in this operation, namely, the high right rectus, midline, and right subcostal gridiron incisions. Each of these has definite objections. The high right rectus incision, the one employed most universally, is easy to make and gives good exposure; however, eventration is too common a complication. To guard against this, tension sutures often are used and are left in place until the wound is firmly healed. By this time marked foreign body reaction and suppuration about these sutures usually occur. The same objections apply to a midline incision.

To avoid these complications a right subcostal muscle splitting incision may be used. In this incision each of the three abdominal muscles are split in the direction of their fibers, and this procedure insures a stronger abdominal wall and makes unnecessary the use of tension sutures. However, this incision is difficult to make inasmuch as the muscles are thin and not easy to identify. Moreover, as the incision is too far lateralward, it does not permit good exposure of the pyloric mass.

A high right rectus gridiron incision has many advantages: it gives a strong abdominal wall as all layers are split in the direction of their fibers—it is a gridiron type of incision; it gives good exposure as it is directly over the pyloric end of the stomach; as the skin lines of the abdominal wall run transversely in this region, it leaves a finer scar; it is not necessary to use tension sutures; the skin sutures can be removed early so there is not much tissue reaction about them; no binder is necessary.

From the Department of Surgery, University of Nebraska College of Medicine.

The technique used in making this incision may be described as follows: Over the upper part of the right rectus muscle a short transverse incision is made through the skin, subcutaneous fat, and anterior sheath of the rectus. The deep surface of the rectus sheath is dissected from the rectus muscle so that these flaps can be retracted upward and downward. The rectus muscle is split longitudinally and retracted to expose the posterior sheath of the rectus. This latter layer with the peritoneum is incised transversely. In closing the wound each of these layers is sutured separately; the peritoneum with the posterior sheath of the rectus, the rectus muscle itself, the anterior sheath of the rectus, and finally the skin.

Meredith uses a right rectus incision but splits the posterior rectus sheath transversely. As far as I know this is the first time that the right rectus gridiron incision as here described has been advocated and used. It is not difficult to make, gives good exposure, and leaves a firm abdominal wall.

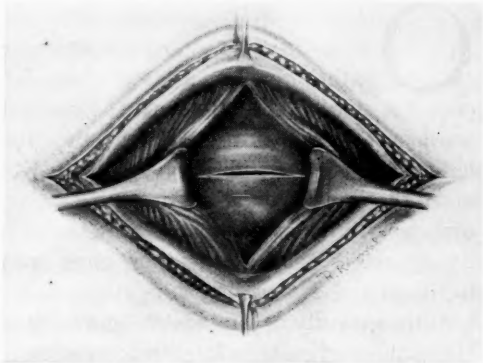

Fig. 1. Right rectus gridiron incision. Transverse incision through skin, fat, and anterior sheath of rectus; vertical incision through rectus muscle and transverse through posterior sheath of rectus and peritoneum.

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ON THE PRONOUNCEMENT OF CANCER

"Oh, what a tangled web we weave, when first we practise to deceive!" *Sir Walter Scott*

ONE of the most unpleasant and delicate duties to confront a physician is the pronouncement of the existence of a cancer. The unfortunate odium that has long attended this disease and the false legends of its incurability have conspired to make the occasional patient accept this diagnosis as a verdict worse than death. The ability to receive such unwelcome news with fortitude and equanimity is an attribute denied the majority of individuals. Inasmuch as the qualities of courage, intelligence, and emotional stability are so variable in humans and because it is the physician's task to treat the mind and spirit as well as the body, no set rule can be formulated for acquainting all cancer patients with the diagnosis and prognosis of their ailment.

This discussion would be unnecessary if it were the universal practice of doctors to make an immediate, direct, and blunt declaration of this diagnosis and to permit the patient and his family to react and adjust themselves as well as possible to this seeming catastrophe. The protagonists of this method of handling the problem might well quote one of the aphorisms of Johann Kasper Lavater, who said: "He who, when called upon to speak a disagreeable truth, tells it boldly and has done is both bolder and milder than he who nibbles in a low voice and never ceases nibbling." It is surprising how much vicarious strength of character some physicians possess for suffering their patients' diseases. One young physician, proud and self-righteous in his avowed habit of telling all the truth, was not deterred by the suicide of one patient, but when another patient jumped from the twelfth story and a third became violently insane while still in the hospital, he was ready to consider the advantages of psychological management over the bare, unvarnished truth. A psychiatrist might point out that the three patients cited had impaired mental backgrounds in the first place and might have behaved similarly to other shocks; nevertheless this does not lessen the obligation of the physician. We cannot limit the occurrence of cancer to the brave and the strong. Furthermore, a patient endowed with the most heroic stoicism at the time of receiving the pronouncement of cancer, may after a few months of insomnia, constant pain, and progressive disability, become almost another individual, desperate and craven, who has lost his courage, but unfortunately not his memory.

The family physician who knows the personality, the character, and the familial environment of the patient, seldom undertakes

the management of the cancer; therefore, it usually falls to the lot of the unacquainted radiation therapist or surgeon to establish the diagnosis, to propose the plan of treatment and to satisfy the inquisition of the patient and his relatives at the initial consultation. Under these circumstances, he faces at once the difficult task of making a rapid and accurate evaluation of the psychological status of the patient and governs his immediate actions accordingly. Although the suspicion of cancer may be present in the mind of each patient, only a few will have the temerity to ask the direct question, "Doctor, do I have cancer?" By this time, the physician probably has decided whether or not to be explicit about the diagnosis, and if so, at what time and in what manner the patient should be told. There are moral, professional, and legal reasons for replying truthfully to the direct interrogation. For example, a responsible, sane individual with great family, economic or social liabilities which are dependent on his well-being, may need to rearrange his plans because of such a diagnosis and the future program it entails. The truth at such a time may be cold and cruel or gentle and merciful, according to the manner of the informer. To allay the apprehension of the patient, to bolster his morale, and to give him an optimistic viewpoint about his condition for the weeks of treatment ahead, considerable stress should be laid on the various encouraging aspects pertaining to his particular cancer.

The physician may be forewarned by the general practitioner or through the intervention of the family not to inform the patient about the true character of his illness. In this case, one should distinguish as Shakespeare did between the lie direct and the lie with circumstance. The reasons for acceding to this request must be important and purposeful, not based on mere sentiment. As Mr. Dooley said, "I think a lie with a purpose is wan iv th' worst kind an' th' mos' profitable." If one is constrained to tell such a white lie to a patient, hysterical, profoundly melancholic, or otherwise mentally unstable, it should be done in the presence of witnesses, preferably the general practitioner in the case or another medical consultant, who agrees as to the necessity for such a procedure. This precaution, especially the signatures of such witnesses, affords protection against possible future legal complications. With such evidence available, the courts of justice would not condemn the altruistic intent of the physician. If the same patient refuses to undergo the radical treatment prescribed under the false assumption that it is unnecessary, or if he procrastinates too long before starting therapy, or if he moves immediately from the community and is no longer under the control of the responsible physician, then secrecy is abandoned and the patient is correctly appraised of the serious character of his disease. One variety of patient, who deserves the utmost candor and veracity is the confused "shopper," whom every doctor recognizes by his familiarity with the subject as revealed in the question he plies. Only direct, unequivocal answers delivered with conviction can influence such troubled patients to accept proper treatment.

One technique not to employ is the gracious smile, the friendly pat on the shoulder, the nonchalant assurance of the minor unimportance of the disease and in the same breath the proposal to do a hip joint disarticulation, a radical mastectomy, an abdominoperineal rectal resection with permanent colostomy or a protracted course of intensive radiation therapy. Such paradoxical behavior leads inevitably to the loss of confidence and respect and convicts the physician either of lying or exercising bad judgment. It is a wise physician who anticipates and forestalls complicat-

ing questions from the patient. The average patient expects the worst and, in the light of the treatment planned for him, is naturally and reasonably dissatisfied or hesitant with any ambiguous explanation or one that doesn't admit the serious character of his disease. This doubt can be dispelled by asserting in the beginning that the patient does have a "tumor" endowed with dangerous potentialities. Proceed to explain that, without early and appropriate treatment, this tumor is capable of changing its localized status and may become generalized. Encourage the patient by the fact that the "tumor" is amenable to therapy and rightly defend the major form of treatment advocated as the procedure most likely to offer the patient the safety he wishes and deserves. The word "cancer" is intentionally omitted from the conversation. The average patient realizes that the disease is really cancerous or perhaps precancerous and agrees to treatment at the same time gratefully appreciating the consideration of the physician in not openly labelling the tumor as "malignant." By avoiding the use of the word "cancer," the patient may always cherish the hope that the tumor had not become cancerous as yet; the patient would rather retain this thread of healthy doubt and uncertainty, than to have once and forever the finality that goes with the pronouncement of cancer. As time goes by the patient becomes fully cognizant of the nature of the disease he has and a tacit understanding develops between him and the physician during the observational years that follow.

Queries concerning prognosis follow the diagnosis as the night the day. A frank discussion of the outlook in any individual case is fraught with certain hazards. A recital of percentage figures for operative mortality and five year survivals, regardless of how good they seem to the professional mind are not particularly reassuring to the patient as they always fall short of perfection. After all, he reasons, I may be one of the fatalities or failures. No cancer is so slight as to be considered insignificant and many cancers apparently hopelessly advanced are sometimes controlled; therefore, the physician who cannot always guide the many intangible influences that may render the early cancer incurable and the advanced cancer controllable, should be most cautious in guaranteeing a cure or dwelling on the futility of treatment respectively. The patient's family will never forgive a guarantee of cure that failed, and the patient will not let the physician forget a pronouncement of incurability if he is so fortunate as to survive.

GEORGE T. PACK

THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

A BOOK which first appeared in 1884 and is now in its thirteenth edition needs little commendation. When he assumed its editorship in 1938, Mr. Bailey[1] "inquired from house surgeons and practitioners what they wanted to find in a book of this kind." The result is a handbook of current English surgical therapy usually learned by house officers in a hospital outpatient department and through their care of surgical patients before and after operation. Diagnosis, pathology, and descriptions of major operative procedures are omitted.

Despite forty contributors to this edition, its literary quality is uniform and pleasing, although the anglicism "and/or" will doubtless be distasteful to Americans. It is well illustrated and fully indexed.

There are a few discrepancies in the choice of material. For example, a satisfactory discussion of the general treatment of fractures is followed by a too brief account of the specific fractures, many of which present problems as major as a gastric resection. On the other hand, there are no descriptions of the general treatment of accidental wounds, local anesthesia, tendon and nerve suture. The decision to include an account of the Ochsner-Sherren delayed treatment of appendicitis is debatable. These few criticisms, however, do not lessen the belief that this book will be of great value to the developing surgeon.

EDWARD M. HANRAHAN.

THE *History of Surgery*[2] by Richard A. Leonardo begins with a consideration of primitive surgery as exemplified by the prehistoric skulls exhibiting trepanation. Next in order are short reviews of Babylonian, Egyptian, Hebraic, Hindu, Chinese, and Japanese surgery. The surgery of ancient Greece, Rome, the Byzantine period and Arabian surgery receive more detailed consideration. The latter sections, and those dealing with the medieval and modern periods are essentially a series of brief personal sketches of the great surgeons of these eras, emphasizing their contributions. The writer, in many instances, presents translations of one or several paragraphs from the works of the surgeon in question. This leads to a greater appreciation of his personality. Furthermore, by direct quotation of some of the original descriptions of operations or other procedures, the reader receives a very graphic impression of how these were first developed. In the latter sections, considerable space is devoted to American surgery. There are also sections on South American, Mexican, and Canadian surgery. Following the main text of 377 pages there is an extensive bibliography, and then an addenda in which the most recent advances in surgery are discussed, including considerable emphasis on the development of surgical specialties. The section on development of surgical societies is especially interesting and a final word is written concerning the boards for certification of specialists. One of the most commendable features of the volume is the collection of 100 photographic plates grouped together at the end. They are full page in size and arranged chronologically. The first depicts prehistoric skulls with trepanations. Included are illustrations of instruments for mumification, ancient surgical instruments, title pages, illustrations and pages of text from many of the great classics of the past. The final plate illustrates the first page of Reginald Fitz's epochal paper "Perforating Inflammation of the Vermiform Appendix."

This volume by Leonardo affords the teacher of surgery a ready reference for the historical background of surgery should he desire to include this in didactic lectures. For the surgeon interested in the history of his field it constitutes a compact, vivid, and very enjoyable tome. ALEXANDER BRUNSCHWIG.

A NUMBER of writers have dealt with the history of medicine, and particularly during the last half century various authors have written about the subject as a whole or of some particular portion of the field, or, perhaps, of some of the outstanding personalities of medicine. Dr. Ricci[3] has chosen the specialty of gynecology as his subject and has produced an interesting piece of work.

He begins with prehistoric gynecology and brings his history down to the end of the eighteenth century. It is impossible to comment in detail upon all of the material which the author has included in the book. The wealth of detail indicates a large amount of reading and research. Chapters on the Talmudic aspect of gynecology, gynecology in Rome, both during its early century A. D., provide an interesting view of the manner of dealing with the ills of women during those periods.

The chapter which deals with the gynecological instruments of the Graeco-Roman period is inter-

[1] PYE'S SURGICAL HANDICRAFT; A MANUAL OF SURGICAL MANIPULATIONS, MINOR SURGERY, AND OTHER MATTERS CONNECTED WITH THE WORK OF SURGICAL DRESSERS, HOUSE SURGEONS, AND PRACTITIONERS. Edited by Hamilton Bailey, F.R.C.S. (Eng.). 13th ed. Baltimore: Williams & Wilkins Co., 1942.

[2] HISTORY OF SURGERY. By Richard A. Leonardo, M.D., Ch.M., F.I.C.S. New York: Froben Press, 1943.

[3] THE GENEALOGY OF GYNAECOLOGY; HISTORY OF THE DEVELOPMENT OF GYNAECOLOGY THROUGHOUT THE AGES, 2000 B.C.–1800 A.D.; WITH EXCERPTS FROM THE MANY AUTHORS WHO HAVE CONTRIBUTED TO THE VARIOUS PHASES OF THE SUBJECT. By James V. Ricci, A.B., M.D. Philadelphia: The Blakiston Co., 1943.

esting, particularly for one who retains a remnant of his Greek.

In the chapter on Byzantine gynecology, from the fourth to the seventh century, we find an interesting consideration of the development of gynecology after the separation of the Roman Empire into the Eastern and the Western Empires. A résumé of the work of Paul of Aegina, which gives many of the remedies used or advised by him, is one of the most interesting portions of this part of the work. This is followed by a discussion of the information found in the Arabian Medical Manuscripts. Here we find the names of Rhazes, Avicenna, Albucasis, and Serapeon the Elder, with a brief consideration of their lives and works.

The Mediaeval period and the School of Salerno provide an interesting section of the book. Those who believe that medicine and theology have little in common will be interested to learn that in the year 580, at Merida, a bishop did a laparotomy for a retained fetus in ectopic pregnancy and that the teacher of St. Thomas Aquinas, Albertus Magnus, Bishop of Ratisbon, wrote a medical treatise entitled "Secreta Mulierum," which, as the author says, is not without an occasional accurate clinical observation. Trotula's treatise is mentioned and its title page reproduced.

The presentation of the beginnings of the study of the anatomy of the generative tract is given somewhat at length with a number of illustrations from the old authors. Vesalius, Bartolomeo Eustachio, Jacques Dubois, and Matteo Tealdo Colombo all appear in the course of the chapter. Admirers of Paré will find numerous allusions to him and a considerable discussion of his work in the chapter concerning Renaissance Gynecology.

It is not possible to mention the large number of well known names which appear in the chapter on the gynecology of the seventeenth century but the story is an interesting one and a number of illustrations accompany it from various of the old works which are mentioned.

The chapter which deals with the gynecology of the eighteenth century is a long one and gives an excellent view of this period. The names of all of the workers whom we have been accustomed to associate with that period of the history of our specialty will be found together with those of some with whom many readers of the book may not have been familiar.

The author has done a large amount of research for the wealth of detail which the book contains could be gotten together in no other way. The bibliographies are ample and contain sufficient references to open the door to the literature of medical history to anyone who is interested in further study of the subject.

This book is an addition to works dealing with medical history and one which will be of value to all those in the field of gynecology and obstetrics who are interested in the men and the practice of former ages.

W. C. DANFORTH.

THE textbook *Roentgenographic Technique* by Rhinehart[1] has served as a standard reference for a large number of technicians over a period of years. It has also proved useful to the roentgenologists.

The new edition has been revised and minor additions have been made to bring it up to date. There has been some rearrangement of material, but no important changes. There are certain details of technique which have been omitted. These deal with highly technical procedures, such as fluororoentgenography, kymography, and laminography, which could have been included.

On the whole, however, this book continues to serve a very useful purpose.

R. G. WILLY.

THE extremities, abdomen, perineum, and pelvis are covered in volume I of *An Atlas of Anatomy*[2] by J. C. Boileau Grant. It contains 227 illustrations of which 122 are in color, with 79 in three or four colors. The labeling and position of each illustration on the pages of this text give the immediate impression of clarity without the "cluttering" of illustration, legend, and labeling which make most atlases a difficult source for desired detail.

Accuracy is obtained by retouching actual photographs of dissection. The plates give that most essential characteristic of third dimension in a most satisfactory manner. This is also achieved through original and unique dissection through most of the large joints. An atlas of surgery should be a selection of plates which demonstrate the layers as encountered by dissection of the respective part. This is achieved in this text.

Although the text is unusually complete, this reviewer regrets the absence of a section through the hand showing the mid-palmar and thenar spaces.

This atlas can certainly be well recommended to all students of clinical anatomy and to surgeons.

SAMUEL J. FOGELSON.

"THE love of life is next to the love of our own face and thus the mutilated crave for help" (Susruta Samhita). Development and improvement in plastic surgery of the face are always important and valuable, especially as applied to the re-forming of functioning lids with protection to the globe and preservation of vision. Therefore, the concise, easily understood thesis, *Reconstruction Surgery of the Eyelids*[3] by Wendell L. Hughes, illustrated clearly with diagrams and photographs co-ordinated with the text is most timely in the present period of multiple mutilations.

The chapters take up in sequence replacement of skin defects with and without pedicle, reconstruc-

[1] ROENTGENOGRAPHIC TECHNIQUE; A MANUAL FOR PHYSICIANS, STUDENTS AND TECHNICIANS. By Darmon Artelle Rhinehart, A.M., M.D., F.A.C.R. 3d ed. Philadelphia: Lea & Febiger, 1943.

[2] AN ATLAS OF ANATOMY; IN TWO VOLUMES. By J. C. Boileau Grant, M.C., M.B., Ch.B., F.R.C.S. (Edin.). Vol. I—Upper Limb, Abdomen, Perineum, Pelvis, and Lower Limb. Baltimore: The Williams & Wilkins Co., 1943.

[3] RECONSTRUCTION SURGERY OF THE EYELIDS. By Wendell L. Hughes, M.D., F.A.C.S. St. Louis: The C. V. Mosby Co., 1943.

tion of the conjunctival layer, of the tarsus and most completely the author's method of blepharopoiesis or replacement of the entire lid. In each section a review of the historical development is followed by a careful description of repair most used at the present time.

The author considers free skin grafts quite satisfactory when the skin is taken from the upper lid to replace defects in the lower. An area 2 by 3 centimeters may be transferred. Skin from other parts of the body is used when necessary but is less satisfactory even when accurately removed by means of the dermatome for color and texture and pliability differ from the original.

Conjunctival grafts are of great importance in protecting against or correcting symblepharon. Dr. Hughes prefers transfer of a conjunctiva when possible, otherwise resorts to buccal mucosa. The mucous membrane may be pregrafted into a flap.

Reports on cases numbered 5, 6, 9 and 11 are very valuable because the entire lid structure was replaced. In case 9, following complete destruction of a lower lid, a tarsoconjunctival flap was brought down from the upper lid and a skin flap from the cheek undermined and slid up; the eye was closed by adhesions between upper lid margin and the edge of the skin graft. Later a lower lash line was inserted using a strip from the opposite brow and still later new lid margins were produced between the lines of hairs. Cosmetic and functional results were excellent. Protection of the globe was accomplished which organ would have been damaged otherwise by exposure. Seven movie films are available covering the described surgery.

This book will prove of value to anyone who is developing his technique of surgery of this region.

EARLE B. FOWLER.

THE author of *Kinetic Bandaging*[1] divides the body into a series of three basic geometric structures: ovoids, cylinders, and truncated cones. Thus a few fundamental principles are all that are involved when bandages are applied to these three basic figures. By acquiring skill in the application of dressings to these elemental units of structure the bandager is able freely to move from one part of the body to another with the utmost ease. This flowing and ready movement from one region to another, until any or all parts of the body surface are covered, without the necessity of memorizing a multiplicity of individual bandages is referred to as "kinetic bandaging."

The type is large and on good quality paper making for easy reading. Descriptions are clear and the step by step illustrations leave little chance for confusion. Each turn of bandage is numbered. Bandaging of all parts of the body are described and illustrated but covered under the three basic geometric designs. For example; the head, finger tips, and tips of the toes are ovoids; the neck, trunk, wrist, and lower legs are cylinders while the forearms, arms, legs and thighs are truncated cones.

It is surprising to see illustrations of such neat bandaging and then to find that in figure 89, page 57, illustrating the fixation of the terminal end of a roller bandage that the upper and lower borders are left free to become ragged and untidy when folding these borders under towards the midline of the bandage, tapering the end to more or less of a point which could be entirely covered with adhesive, would give a neat and graceful termination. The same is true for figures 90 and 91 on page 58 where the terminal end of the bandage is made secure with a safety pin. These criticisms may seem trivial but the author is striving for neat as well as efficient bandaging. All but the last illustration in figure 5, page 12, are confusing to the reviewer since they give the erroneous impression that the roller bandage is to be carried to the left rather than to the right.

This profusely illustrated book on bandaging is indeed timely. The author expresses the hope that it will prove of value to the Army and Navy Medical Corps personnel, Red Cross workers, and others directly or indirectly concerned with the care of the wounded. Certainly it will be of great value to any person required to teach or practice bandaging.

EARL O. LATIMER.

THE small, pocket-sized, *Oxford War Manual* of about 100 pages, *The Ear, Nose and Throat in the Services*[2], is well adapted for its purpose. That is, the fundamentals of the common diseases of the ear, nose, and throat are presented in a brief manner for the physician in the war service whose training has been for fields other than the ear, nose, and throat.

It is written in a chatty, abbreviated manner, largely from the symptomatic viewpoint so that the medical officer would recognize the more common ailments and be able to give the usual first aid. The illustrations are rough sketches but adequate in most instances. Surgical technique has not been stressed except for the more urgent procedures such as tracheotomy or the opening of abscesses and so forth.

The author has used excellent judgment in a conservative way in his various therapeutic measures. The book, as a whole, is readable and authentic in the brief territory covered. H. C. BALLENGER.

AS is indicated by the authors in the foreword to the book, *A Hundred Years of Medicine*[3] by Haagensen and Lloyd, is written with an appeal more to the layman than the physician.

The book is divided into four general divisions with the first dealing with the history of medicine up to a hundred years ago and is almost entirely

[1] KINETIC BANDAGING; INCLUDING SPLINTS AND PROTECTIVE DRESSINGS: THE KINETIC METHOD OF VISUAL TEACHING. By Seymour W. Meyer, B.S., M.S., M.D. Philadelphia: F. A. Davis Co., 1943.

[2] THE EAR, NOSE AND THROAT IN THE SERVICES. By R. Scott Stevenson, M.D., F.R.C.S. Ed.; Major R.A.M.C. Oxford War Manuals. Edited by The Rt. Hon. Lord Horder, G.C.V.O. London: Oxford University Press (Humphrey Milford), 1943.

[3] A HUNDRED YEARS OF MEDICINE. By C. D. Haagensen and W. E. B. Lloyd. New York: Sheridan House, 1943.

historical in nature. The second division is devoted to medical science as contrasted to the surgical aspect. The third section takes up the changes that apply more specifically to surgical procedures. The fourth part considers the many social aspects of medicine.

Under the second division consideration is given to the early history of pathological and bacteriological research, the care of tuberculosis, a study of the vitamins, and the chronic diseases. The third division considers the progress from McDowell's first ovariotomy through early anesthesia, the control of infection associated with operation, the prevention of surgical shock, the discovery and uses of radiant energy, and some of the more important procedures n the specialized types of surgery. A short and very interesting chapter is devoted to the origin and development of the "trained nurse."

The fourth division of the book is given to the social aspect of medicine and includes such subjects as cost of medical care, sickness insurance, and a study of the various income levels and the amount expended for medical care. It also includes an interesting chapter on the development of medical education in schools and hospitals.

The authors have made a very valuable addition to the history of medicine from its early feeble efforts to the present high grade type offered to the public. The book, however, will appeal more to the lay reader than the physician to whom most of the material is already known. It is a valuable addition to any library. WILLIAM G. ALEXANDER.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

MEDICAL RADIOGRAPHIC TECHNIC. Prepared by The Technical Service Department of General Electric X-Ray Corporation. Edited by Glenn W. Files, Director. Springfield, Ill., and Baltimore, Md.: Charles C. Thomas, 1943.

A MEDICAL BIBLIOGRAPHY; A CHECK-LIST OF TEXTS ILLUSTRATING THE HISTORY OF THE MEDICAL SCIENCES. By Fielding H. Garrison, M.D., and Leslie T. Morton. London: Grafton & Co., 1943.

NASCENT ENDOCRINE THERAPY. By John Franklin Ritter, M.D. Caldwell, Idaho: The Caxton Printers, 1940.

HISTEROSALPINGOGRAFÍA. By Eduardo Buteler. Córdoba, Argentina: Universidad Nacional de Córdoba, 1943.

THE MODERN MANAGEMENT OF COLITIS. By J. Arnold Bargen, M.D., M.S., F.A.C.P. Springfield, Ill., and Baltimore, Md.: Charles C. Thomas, 1943.

THE 1943 YEAR BOOK OF INDUSTRIAL AND ORTHOPEDIC SURGERY. Edited by Charles F. Painter, M.D. Chicago: The Year Book Publishers, Inc., 1943.

EXPECTANTLY YOURS; A BOOK FOR EXPECTANT MOTHERS AND PROSPECTIVE FATHERS. By Mario A. Castallo, A.B., M.D., F.A.C.S., and Audrey Walz. New York: The Macmillan Co., 1943.

THE ARTHROPATHIES; A HANDBOOK OF ROENTGEN DIAGNOSIS. By Alfred A. deLorimier, A.B., M.A., M.D. Chicago: The Year Book Publishers, Inc., 1943.

WAR WOUNDS AND INJURIES. EDITED BY R. MAINGOT, F.R.C.S., E. G. SLESINGER, O.B.E., M.S., F.R.C.S., AND ERNEST FLETCHER, M.A., M.B., F.R.C.P. With a foreword by Lord Horder. 2d ed. Baltimore: The Williams & Wilkins Co., 1943.

TRANSACTIONS OF THE SIXTY-FOURTH MEETING OF THE AMERICAN SURGICAL ASSOCIATION; Held at Netherland Plaza Hotel, Cincinnati, Ohio, May 13–14, 1943. Edited by Walter Estell Lee, M.D. Vol. 61. Philadelphia: J. B. Lippincott Co., 1943.

AMERICAN COLLEGE OF SURGEONS

PLANS FOR 21 WAR SESSIONS IN 1944

THE American College of Surgeons announces plans for a series of one-day War Sessions to be held in 21 cities, well distributed throughout the United States and Canada, in February, March, and April, 1944.

The cancellation of the 1943 Clinical Congress makes it especially desirable to continue the War Sessions as means of informing the profession concerning the developments in medicine and in the conditions affecting medical practice and hospital care which have been rapidly occurring under the pressure of wartime events. The enthusiastic reaction to the similar series of meetings held in 1942 and 1943 is another reason for planning the War Sessions in 1944. Advancements in military medicine and developments in civilian medical research and practice under the spur of the war emergency will provide abundant material for an intensely interesting program for each of the 1944 meetings.

As in the two previous years, the College is assured of complete co-operation by the official war services of the Government. The United States Army, Navy, Public Health Service, Veterans Administration, Procurement and Assignment Service, and the Office of Civilian Defense, are assigning representatives to participate in the meetings. In the hospital conferences, such agencies as the War Production Board, the War Manpower Commission, the American Red Cross, and the Division of Nursing Education of the United States Public Health Service which has jurisdiction over the United States Cadet Nurse Corps, will be represented. Medical service in industry and the work of committees of the medical division of the National Research Council will also be prominently featured in the scientific program. The developments in civilian medical and surgical practice will be presented by national authorities, some from within the area covered by the meeting, and others who come from greater distances.

For the four meetings which are to be held in Canada, members of the Canadian Medical Service who have recently returned from overseas, as well as those who are serving in the country, will participate. The present outlook is that a three-day refresher course for members of the military services (Army, Navy, and Air Force) will be timed directly to follow the War Sessions in Winnipeg, thus permitting those attending the course to participate also in the College meeting by coming a day earlier. The Montreal, Toronto, and Vancouver meetings also promise to be well attended and the local profession in each city has expressed keen interest in the arrangements. The committees in charge of the various War Sessions in Canada have expressed the hope that the Surgeons General of the United States Army and Navy may participate in their meetings, and the Surgeons General are hopeful that they may be able to be present at some of the War Sessions at least.

PURPOSES OF THE WAR SESSIONS

One of the primary purposes of the War Sessions is to bring directly to the physicians and to hospital personnel, in a convenient location, information from authorized representatives of the various federal services that will help them to understand the immediate problems of these services and enlist their co-operation in attaining the objectives that will continue to help in winning the war. In turn, doctors and hospitals are provided opportunities to present their problems directly to officials who can be of help in their solution.

An outstanding benefit derived from the War Sessions has been the effecting of better mutual understanding and co-operation between the various government services and the medical profession and hospitals in general. The recruitment of medical officers for the military services has been furthered through the meetings, while at the same time due emphasis has been placed upon the necessity of maintaining adequate medical and hospital service for the civilian sick and injured.

The War Sessions are designed for the benefit of physicians and surgeons at large, medical officers of the Army and the Navy, residents, internes, medical students, and executive personnel in hospitals, and, of course, for junior candidates and fellows of the American College of Surgeons.

Those who plan to attend may select the meeting which in place or time is most convenient,

regardless of the states and provinces which, for the purposes of organization, are designated on the list as participating in a given meeting.

The general outline of the program for each of the meetings is shown in the accompanying schedule. Some adaptations of this outline will, of course, be necessary in the programs for the meetings in the four cities of Canada. Canadian officials and fellows of the College have formed committees to plan the programs for the meetings in Canada.

It is planned to feature among the scientific presentations at every meeting the experiences of physicians and surgeons who have been on active duty in combat zones.

Suggestions for subjects to be included in the programs, discussion to be from the standpoint of actual experience, are as follows: types of wounds of modern warfare, evaluation of the use of sulfa compounds, compound injuries, status of treatment of burns, treatment of fractures, status of penicillin, aviation medicine and surgery, transportation of the wounded, rehabilitation, industrial medicine, endemic and epidemic diseases, and civilian surgery.

The programs will include panel discussions and round table conferences in addition to the formal presentations. Since physicians and surgeons in civilian life are too busy to prepare clinical programs, demonstrations in hospitals will be omitted as has been the practice in the previous War Sessions. Many subjects of nonmilitary nature, and some that have come to the forefront in war medicine but that also affect civilian practice, will be discussed at each meeting.

PROCUREMENT AND ASSIGNMENT SERVICE

At the luncheon meeting, vital problems pertaining to the supply of medical officers for the Army with special reference to the 9—9—9 plan for internes, assistant residents, and residents and the allocation of nurses, will be presented by a representative of that service. Both in the United States and Canada, there will be, for the duration of the war, many problems to meet in supplying physicians and nurses for the military services as well as for civilian practice.

CIVILIAN DEFENSE

The United States Office of Civilian Defense, in a release dated December 8, announced that 93 hospitals and medical schools scattered throughout the country have completed formation of "affiliated units" of civilian physicians which will be available to either the Office of Civilian Defense or the Army in the event of need for setting up emergency hospital facilities in their respective areas. Each unit is composed of 15 physicians, surgeons, and other specialists, and forms a balanced professional staff. The Office of Civilian Defense will use the units to supplement the staffs of "emergency base hospitals" located in relatively safe zones on the fringes of critical areas in case it is necessary to transfer civilian patients to these hospitals because of emergency in such areas. The units will be called upon by the War Department to staff extemporized hospitals should there be a sudden influx of battle-front casualties, or some other extraordinary military necessity, requiring hospitals and physicians beyond the immediate capacity of the Army in any particular locality.

To discuss this and other developments which may arise between now and the dates of the War Sessions, the programs in both the United States and Canada will include the subject of civilian defense.

Series of motion picture films of surpassing interest and value on medical and surgical subjects have been produced by the United States Army and the United States Navy. Those in attendance at the War Sessions will be privileged, through the courtesy of the Army and the Navy, to view these films which include such subjects as evacuation of the wounded, treatment of fractures, effects of treatment of victims of bomb blast, and newer methods of treating burns and other wounds.

Intensive study of methods of relieving the difficulties under which hospitals are laboring in wartime is planned for the hospital conference to be held simultaneously with each War Session. Adjustments to the new 9—9—9 plan in the United States which will then have been in effect for several months, will be discussed. The importance of maintaining graduate training programs in medicine and surgery will be emphasized. The new United States Cadet Nurse Corps and its effectiveness in relieving the shortage of nurses, and the procurement and assignment program for allocation of nurses, will be among the subjects covered. Other subjects will be the accelerated program of nursing education, the extent to which nurses may safely be permitted to perform duties formerly delegated to internes and other physicians, the extent to which nurses' aides should be allowed to perform tasks formerly delegated to nurses, the use of volunteer workers in various departments of the hospital, purchasing and maintenance problems, training programs for new personnel, meeting increased demands for hospital service, maintenance of high

standards of service, and preparation for post-war adjustments. Similar programs covering hospital problems in Canada, will be formulated in co-operation with Canadian hospital executives.

The program for each dinner meeting will consist of an open forum for the purpose of introducing for informal discussion any and all subjects presented during the day, together with other problems of interest to the medical and hospital professions. The participants in the day's program will serve as a panel of experts in this forum.

Well in advance of the War Sessions, programs will be mailed to physicians and hospitals in each area. Announcements will also be published in the medical and hospital journals, so that ample opportunity will be provided for the making of reservations for transportation and for hotel accommodations, the need for both of which, of course, will be minimized by the local character of the meetings.

PROGRAM FOR ONE-DAY WAR SESSIONS IN THE UNITED STATES

Preliminary Program for the Medical Profession

8:30–9:30 a.m. Motion Picture Films: Special showing of official U. S. Army and U. S. Navy films on medical and surgical subjects: Evacuation of the Wounded; Treatment of Fractures; Bomb Blast Injuries; Burns; Wounds, etc.

9:30–10:30 a.m. Report by representatives of the U. S. Army who have been on active duty abroad.

10:30–11:30 a.m. Report by representatives of the U. S. Navy who have been on active duty abroad.

11:30–12:00 noon. Report on measures for the control of endemic and epidemic diseases by a representative of the U. S. Public Health Service.

12:15–2:00 p.m. Luncheon Conference on current problems of the U. S. Procurement and Assignment Service. Presentation by a representative of the Service.

2:15–5:00 p.m. Three scientific presentations by medical members of the armed forces and by civilian members of the medical profession. Scientific presentation by a representative of a medical service in industry. Presentation of the program of the U. S. Veterans Administration.

5:00–5:30 p.m. The need for protective services in time of war by a representative of the U. S. Office of Civilian Defense.

6:30–9:30 p.m. An open forum with all participants in the day's program as the panel of experts. Any and all subjects which have been presented during the day, together with other problems of interest to the medical and hospital professions, to be open for discussion. Dinner meeting.

Preliminary Program for Hospital Conferences

8:30–9:30 a.m. Motion Picture Films: Special showing of official U. S. Army and U. S. Navy films on medical and surgical subjects: Evacuation of the Wounded; Treatment of Fractures; Bomb Blast Injuries; Burns; Wounds, etc.

9:30–11:30 a.m. Overall analysis of wartime hospital problems and how they are being solved.

11:30–12:00 noon. Report on measures for the control of endemic and epidemic diseases by a representative of the U. S. Public Health Service.

12:15–2:00 p.m. Luncheon Conference on current problems of the U. S. Procurement and Assignment Service. Presentation by a representative of the Service.

2:15–5:00 p.m. Round Table Conference on "Problems Affecting Wartime Hospital Service": Procurement and Assignment Service—The 9-9-9 plan for internes and residents; U. S. Public Health Service—U. S. Cadet Nurse Corps; American Red Cross Volunteer workers; War Manpower Commission—training courses; War Production Board—hospital equipment and supplies; Office of Price Administration—food rationing; American Hospital Association—Wartime Service Bureau; American Medical Association—education; American College of Surgeons—hospital standards.

5:00–5:30 p.m. Need for protective services in time of war by a representative of U. S. Office of Civilian Defense.

6:30–9:30 p.m. An open forum with all participants in the day's program as the panel of experts. Any and all subjects presented during the day, together with other problems of interest to the medical and hospital professions, to be open for discussion. Dinner meeting.

SCHEDULE FOR 1944 WAR SESSIONS

Date	City	States, Provinces	Hotel Headquarters
Monday, February 28	Winnipeg	Manitoba, Saskatchewan	Fort Garry
Thursday, March 2	Minneapolis	Minnesota, North Dakota, South Dakota	Nicollet
Saturday, March 4	Des Moines	Iowa, Nebraska, Missouri	Ft. Des Moines
Monday, March 6	Chicago	Illinois, Wisconsin	Stevens
Wednesday, March 8	Cincinnati	Ohio, Kentucky, Indiana, West Virginia, Tennessee	Netherland Plaza
Friday, March 10	Detroit	Michigan	Statler
Monday, March 13	Rochester	New York State	Seneca
Wednesday, March 15	Toronto	Ontario	Royal York
Friday, March 17	Montreal	Quebec, New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland	Mount Royal
Monday, March 20	Springfield	Massachusetts, Maine, New Hampshire, Vermont, Rhode Island, Connecticut	Kimball
Wednesday, March 22	Philadelphia	Pennsylvania, New Jersey, Delaware	Bellevue-Stratford
Friday, March 24	Baltimore	Maryland, District of Columbia, Virginia, North Carolina	Lord Baltimore
Monday, March 27	Jacksonville	Florida, Georgia, Alabama, South Carolina	George Washington
Friday, March 31	San Antonio	Texas, Louisiana, Mississippi, New Mexico, Mexico	Gunter
Tuesday, April 4	Tulsa	Oklahoma, Kansas, Arkansas	Mayo
Friday, April 7	Denver	Colorado, Wyoming, Western Nebraska	Cosmopolitan
Tuesday, April 11	Salt Lake City	Utah, Southern Idaho	Utah
Friday, April 14	Spokane	Washington, Northern Idaho, Oregon, Montana	Davenport
Tuesday, April 18	Vancouver	British Columbia, Alberta	Vancouver
Monday, April 24	San Francisco	Northern California, Nevada	Mark Hopkins
Thursday, April 27	Los Angeles	Southern California, Arizona	Biltmore